FLIGHT

The AIRCRAFT ENGINEER & AIRSHIPS

First Aero Weekly in the World

Founder and Editor: STANLEY SPOONER

A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport

OFFICIAL ORGAN OF THE ROYAL AERO CLUB OF THE UNITED KINGDOM

No. 622 (No. 48, Vol. XII.) | NOVEMBER 25, 1920 | Weekly, Price 6d. Post free, 7d.

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The Aircraft Engineer and Airships

Editorial Offices: 36, GREAT QUEEN STREET, KINGSWAY, W.C. 2

Telegrams: Truditur, Westcent, London. Telephone: Gerrard 1828

Annual Subscription Rates, Post Free:

United Kingdom .. 30s. *4d.* Abroad .. .. .. 33s. *od.**

These rates are subject to any alteration found necessary under abnormal conditions and to increases in postage rates

* *European subscriptions must be remitted in British currency*

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Dec. 2 ... **Lectures, "Airship Piloting," by Major G. H. Scott, C.B.E., A.F.C., "Airship Mooring," by Flight-Lieut. F. L. C. Butcher, before R.Ae.S., at Royal Society of Arts**

Dec. 16 **Lectures, "Possible Developments of Aircraft Engines," by Mr. H. Ricardo, and "The Instalment of Aeroplane Engines," by Mr. A. J. Rowledge, before R.Ae.S., at Royal Society of Arts**

EDITORIAL COMMENT

An Ill-Fated Publication

WE have before us one of the most pathetic examples of aviation journalism it is possible to imagine. This is the first, and we fear the only, issue of a journal called *Nash Stikhi* ("Our Sphere,") produced under great difficulties by the Russian Air Service operating with the armies of Gen. Wrangel in the Crimea. By a tragic coincidence, this journal reached us on the very day that the news arrived in England of the complete defeat of Gen. Wrangel's armies by the Bolshevists and his ejection from the Crimean area. Produced as it has been under the stress of War conditions, "Our Sphere" possibly leaves something to be desired from the point of view of journalism pure and simple, but it has an interest peculiarly its own, not only because of the circumstances of its production, but on account of the light it sheds on the undoubted enthusiasm with which Gen. Wrangel's air service, under the direction of Gen. Tkatchov, have regarded their work in the field and the high hopes of the future obviously entertained by the *personnel*. These last have been dashed to the ground by the rapid march of events since the issue was published, and in the circumstances there is possibly no need to discuss what might have been had they moved differently. There is, however, much that is of interest in this ill-fated publication. From our own point of view, this mainly centres about the high valuation of aviation which is obviously entertained by the "Red" Government of Russia. Many have in this country been rather inclined to the belief that the Red armies were short of aviation supplies, and that in any case the staffs attached very little importance to the aerial arm. We learn, however, that so seriously do they actually take it that they have established an aviation school near Moscow, where considerable work is being done in research and experiment, the teaching of flying, and practical work. An order, signed by Trotsky, is printed, setting forth that nothing is to be spared either on the scientific or practical side which will assist to build up a powerful air service. Apparently, the school is already bearing fruit, because while in the earlier days of the campaign the Reds could muster no more than about eleven machines, at the time the issue of "Our Sphere" was printed they had three or four similar formations in the air against Wrangel's forces. They had one of these squadrons at Tamani, whence they seem to have carried out bombing raids on Kertch, though not without retaliation, since it is recorded that this aerodrome was bombed by Wrangel's aeroplanes. Evidently, aviation is by no means a dead letter even in Bolshevist Russia.

Not the least pathetic feature of this journal is a list of Russian aviators whose obituaries are recorded, most of these "martyrs of Russian aviation"

having died of typhus. This in itself is an eloquent evidence of the terrible conditions under which the civil War in South Russia has been waged. The deadly typhus fever is caused mostly by starvation and overcrowding. It cannot exist save in the very worst sanitary conditions, and its appearance in an army is enough to indicate that it has reached the limits of endurance. What the conditions have really been we cannot imagine, and shall probably never know with certitude—possibly it were better we did not. We can do neither more nor less than salute with admiration the gallant men who have made so magnificent a fight against all that Bolshevism means, and express what sympathy we may with their failure against all the odds.

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An Interesting Project

Can airships be run like trolley-cars? That seems to be the question propounded by the projector of a new airship service between Portsmouth and Ryde. The idea has been conceived by Mr. J. D. Roots, a well-known pioneer of the motor-car and an engineer of considerable attainments. He proposes to erect a cable-way between five and six miles long, from which small airships will pick up electric current for purposes of propulsion, altitude being maintained by ballasting and valving in the ordinary way. It is believed that the technical difficulties can be readily overcome, and that the cost of electric traction will be much lower than that of the more orthodox method of propulsion. As to that, we have a perfectly open mind, and are, naturally, much interested in the development of the scheme. Obviously, such a method of power transmission can only be used over very short distances—assuming that it is practical at all, of which we are not altogether convinced at the moment. In fact, we regard the scheme as a very interesting one, with certain possibilities which may or may not be realised, but which is nevertheless an experiment which we shall be glad to see tried out.

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Army Officers for the R.A.F.

Having regard to all the circumstances of the two Services, it has been decided by the War Office and Air Ministry jointly that a certain number of junior officers of the Army are to be seconded for service with the R.A.F. in order to obtain a full technical knowledge of the work and policy of the aerial Service. A few officers have already been seconded, and their appointments to the R.A.F. are to be gazetted forthwith. In continuation of the policy laid down, the War Office is calling for volunteers for service with the Air Force, and from these will be selected thirty officers whose attachment will begin in March next. The officers selected will be between 22 and 28 years old, and will be seconded for four years. They must have at least two years' commissioned service, and be passed fit by the special Aviation Medical Board. It has been decided that these officers shall be given temporary commissions in the R.A.F., in which they will take rank and command accordingly, while they will receive the pay and allowances of their substantive rank in the Army or Air Force according to which is the more advantageous to themselves. Their service while seconded will count towards pension. The scheme is to be reciprocal, though the numbers of Air Force officers attached to the Army will not be as great. The R.A.F. being largely composed of officers who, up to a comparatively recent date, were trained in military duties, it will not be necessary to detach many at present, but a beginning is to be made next year, and the number will be raised as time goes on.

On the face of it, the scheme seems to be a good one. It would obviously be disastrous to effective co-operation in War if the Army and the Air Force had no mutual knowledge of each other's methods and policy. It must be a considerable time, however, before officers of junior rank can make their views effective in the Army, when they have returned from service with the Air Force. We are able to appraise with some amount of certainty the exact notice which is likely to be taken of the ideas of a subaltern officer by his seniors, and from this point of view we are a little inclined to wonder whether there is a "nigger on the fence" in a scheme which, at first sight, seems admirable. Speaking purely from the point of view of the layman, we should have said that the objects in view would have been better attained by the attachment of officers of field rank in order to give them an opportunity of the study of Air Force methods of administration and of air strategy in its relation to the other Services.

We cannot forget in these connections that both Army and Air Force are still under the supreme direction of a dual Minister, nor that there has been persistent intrigue at the War Office to regain complete control of the aerial arm. We should be sorry to think that this new scheme is part of an insidious plan to insert the thin end of the wedge of Army control of the Air Force, but we cannot in all the circumstances completely divest ourselves of the suspicion that there is rather more in it than meets the eye. More particularly as there seems to be no idea of the Admiralty following out the same plan, although there would appear to be at least equal need for interchange between the Navy and the Air Force. Indeed, there is more, since the strategy of the sea war and the training for giving effect to it are far less understood by Air Force officers than the corresponding problems of land warfare. Further, the exact rôle to be played by the Air Service in co-operation with the Navy is also in all probability less appreciated by the Navy than similar co-operation with the Army is understood by the War Office.

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A Single London Air Port

In a very short time most of the air traffic in and out of London will be dealt with at Waddon, and the Cricklewood aerodrome will cease to be used as it is now. One reason is that the present arrangements mean the duplication of Customs and other staffs, while there is not enough aerial traffic to justify the keeping up of two big aerodromes. Furthermore, practically the whole of the traffic comes in on the south side of London, and the Waddon aerodrome is very much better situated for dealing with it. Of course, as traffic develops, particularly internal traffic, it will be necessary to lay down fresh aerodromes on the north side of the Metropolis, in which case there is more than one good site available near Hendon. It is understood that in any case the Cricklewood site will not again be utilised for the purpose, though the constructional works and the Handley Page Transport Co. remain unaffected for the present at least.

The decision appears to be a wise one. There is no sense in keeping on an aerodrome for which there

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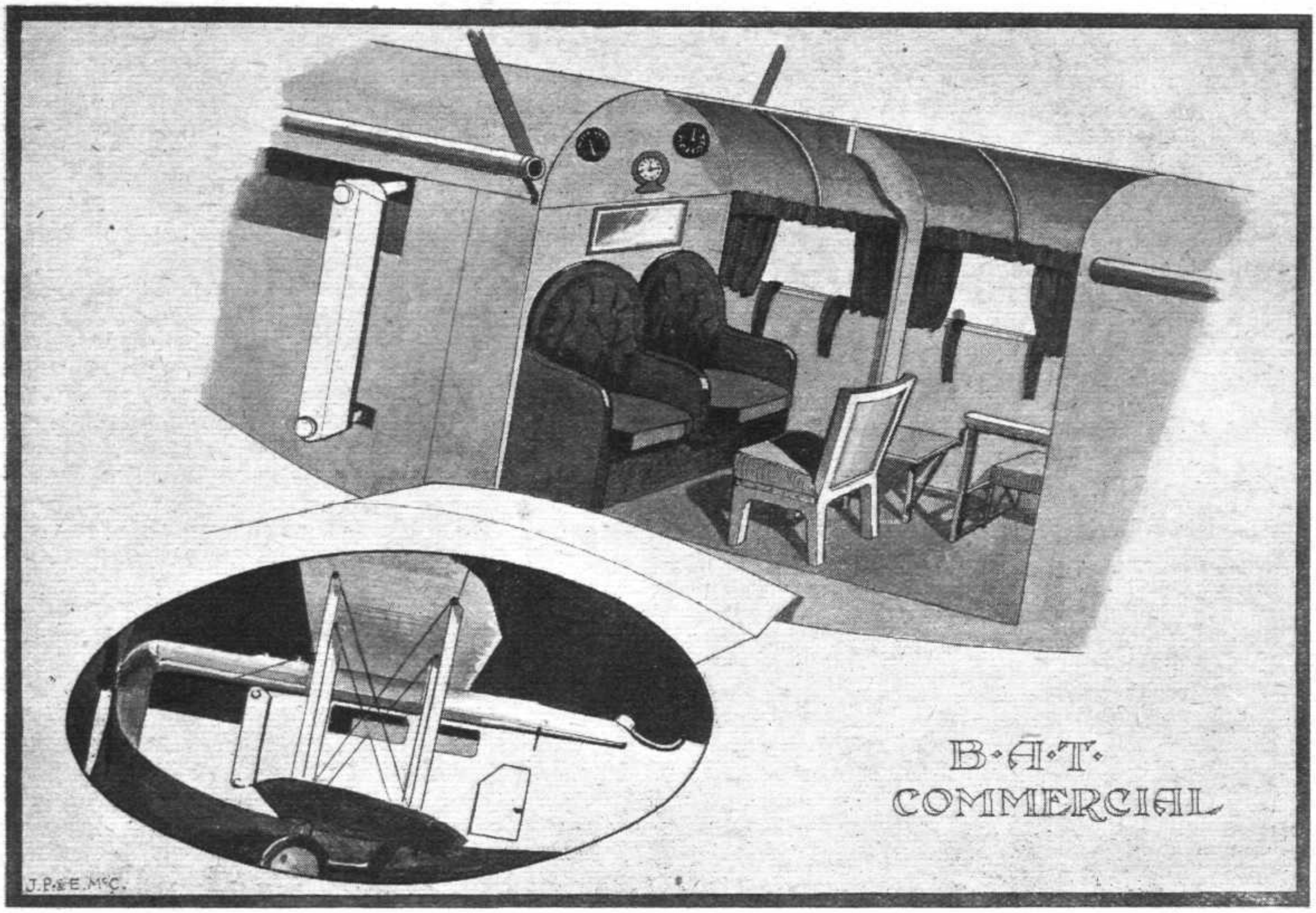
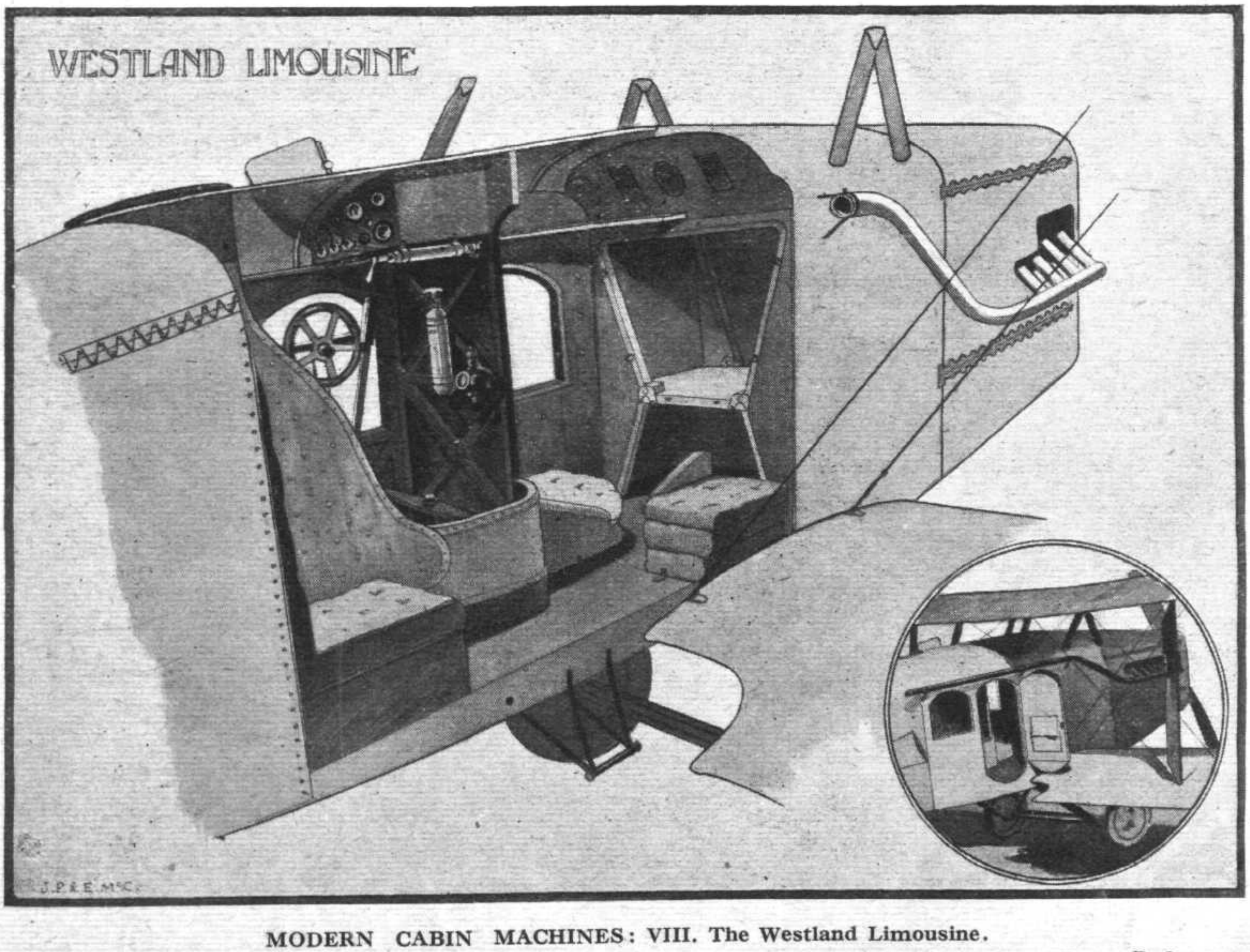


MODERN CABIN MACHINES: VII. The B.A.T., F.K. 26.



MODERN CABIN MACHINES: VIII. The Westland Limousine.

is really little use at the moment, with the attendant overlapping of expensive staffs and services. Naturally, it is with some considerable regret that we hear of the decision, because of the hope which has failed to fructify that by this time we should have had enough commercial air services in being to call for the maintenance of this and other aerodromes as well. Still, circumstances are as they are and not as we would have them, so there is nothing to be done but to record the facts and agree with what appears to be a sound policy.

A Menaced Industry

An industry which is one of the "keys" to aviation—as well as to mechanically propelled transport of all kinds—is the magneto trade. Its development is only to be measured by the advance of the internal combustion engine and without it the latter is an impossibility in so far as most of its uses are concerned. It is a matter of common knowledge that at the beginning of the late War there was no British magneto industry, unless we care to dignify a total national output of some hundred or so machines a week by the name of "industry." Fortunately for ourselves there were in stock in this country many thousands of German magnetos, and these, together with what could be obtained from America, kept us going during the interval which was occupied in creating an industry to cope with the needs of war.

Such an industry was created, and very successfully. When the War ended, we were making enough magnetos to supply all our own normal requirements and to leave a substantial margin for export. There seemed to be a reasonable prospect of Britain taking the place in the world's magneto market which, before the War, was occupied by Germany. At least we could hold our own markets. But what has actually happened? When the Government discovered, early in the War, how vitally we were handicapped by dependence upon foreign countries for certain essentials, it compiled a formidable list of "key" industries which must, after the War, be protected against competition—particularly unfair competition—irrespective of the particular branch of economic faith held by the Government of the day. Among those industries was the magneto trade. But it has not been so protected, and the net result is that Germany is dumping magnetos here at prices a little more than half of those at which the British machine can be sold. The first consequence is that 70 per cent. of the workers normally employed in the British factories are either out of work altogether, or are on short time. The second, and even more serious, consequence is that a trade which was created for the purposes of the War and which is absolutely vital to the air and mechanical transport services is rapidly being extinguished by the subsidised competition of our late enemy. Nor does the Government seem to care whether the industry—together with the rest of the "keys"—lives or dies. The promised protection for these industries is not even in sight, since the latest is that the proposed Anti-Dumping Bill will not be brought in during the present session of Parliament. Germany seems still to have some very good friends in high places in this country.

R.A.F. SHORT SERVICE COMMISSIONS

THE Air Ministry announces:—

The regulations issued in August, 1919, whereby provision was made for obtaining part of the officer *personnel* of the Royal Air Force by granting short service commissions for a period of three years, with a possible extension to four years (*a*) To officers then serving, and (*b*) To demobilised officers, have been revised.

The new regulations extend the right of entry for short service commissions to civilians, and make service on short service commissions by direct entry from civil life a permanent feature of the Royal Air Force, thus maintaining the necessary proportion of junior officers and providing a steady flow into the Reserve.

Applications for short service commissions, under the new regulations can, therefore, now be submitted for a course of training which commences on February 1 next year.

The candidates must not be less than 19 and not more than 25 years of age at the time of entry. They must be of pure European descent and the sons of natural-born British subjects. Each candidate will be examined by a Medical Board and interviewed by a Selection Committee in London.

Employment will be for a period of four years on the active list, followed by a period of service in the Reserve. During the period of service on the active list, an officer may be called upon to serve in connection with any type of aircraft in any part of the world either ashore or afloat.

The rates of pay and allowances and the conditions of issue will be those normally in force from time to time for permanent officers of the Royal Air Force. Officers transferred to the Reserve after completion of their full period of service on the active list, will be paid a gratuity of £75 for each completed year of active service at full pay and will be paid retaining fees whilst in the Reserve subject to satisfactory completion of the training required.

Copies of the detailed regulations may be obtained by application *in writing* to the Secretary, Air Ministry, (S.7), Kingsway, London, W.C.2.

In addition to the candidates required for the course of training commencing on February 1, a limited number of candidates will also be required later for courses commencing on May 1, June 1, July 1, and October 1, 1921.

Selection Committees will be held at the Air Ministry in connection with the different courses about December 15, 1920, March 15, 1921, April 15, 1921, May 15, 1921, and August 15, 1921, respectively.

Intending applicants who, after reading the regulations, are desirous of being considered, may obtain a form of application by applying *in writing* to the Secretary, Air Ministry, (S.7), Kingsway, London, W.C.2. Applications must be received at the Air Ministry a clear week before the date of the Selection Committee at which the Candidate wishes to be examined.

There are also vacancies for a number of demobilised pilots of the Royal Air Force for entry at an early date. All applicants will be considered, provided that they have not been interviewed by an Air Ministry Selection Board subsequent to August 31, 1920.

A.F.C. for Australian Flyers

IT was announced in the *London Gazette* of November 23 that the King has been graciously pleased to approve of the undermentioned rewards to the officers named below in recognition of the valuable services rendered to aviation by their successful flight from England to Australia:

Air Force Cross.

Lieut. Raymond John P. Parer, Australian Flying Corps.
Lieut. John Cowe McIntosh, Australian Flying Corps.

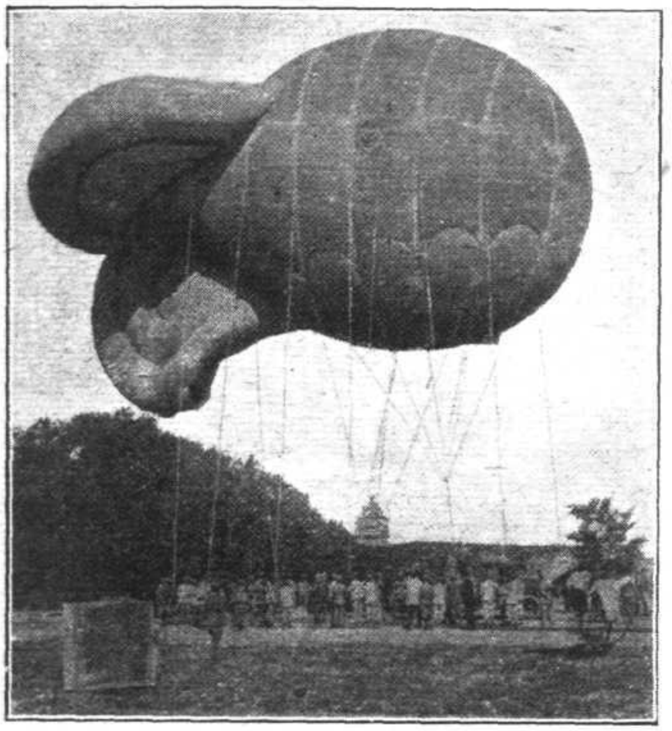
Canadian Defence

SIR ARTHUR CURRIE has recommended to the Government the creation of a Committee for Defence, and the appointment of an Advisory Parliamentary Committee to study military questions, according to *The Times* correspondent at Toronto.

It is suggested that the Parliamentary Committee should consist of 25 members, appointed annually, while the Prime Minister, the Minister of Finance, the Minister of Defence and the chiefs of staff of the Militia, Navy, and Air Force should form the Defence Committee.

THE AVORIO-PRASSONE KITE BALLOON

A VERY considerable amount of progress has been made—especially during the late War—in the development of the captive observation balloon since the early days of aeronautics, when the ordinary spherical balloon was employed. This first application of the spherical balloon was by no means satisfactory, as the balloon was very unstable, could not be kept head to wind, and pitched and rolled considerably. The introduction of the German Parseval "kite" balloon, with its wind-fed air ballonet, overcame these difficulties to a certain extent, and the employment of stabilising fins,



THE AVORIO-PRASSONE KITE BALLOON: The balloon about to ascend.

also wind-fed—as in the Caquot type kite balloon—improved matters still further.

It is of interest to note the wind-fed air ballonet arrangement referred to above is similar in principle to the large kites or paper air balloons used by the Chinese and Japanese many hundreds of years ago!

Whilst the Parseval type was much more stable than the anchored spherical balloon, it was still somewhat difficult

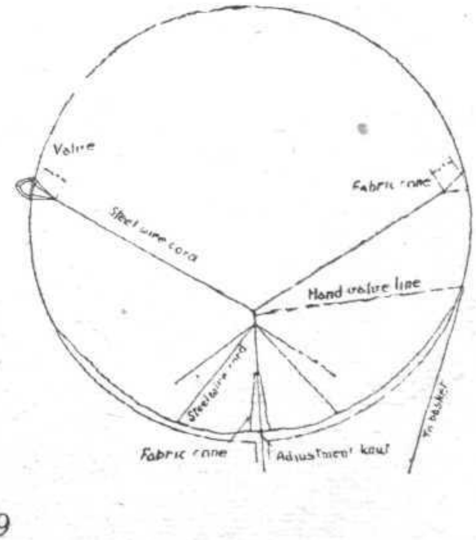
THE AVORIO-PRASSONE KITE BALLOON: The gas valve on the A.P. balloon, made of wood to avoid electrical discharges.

to handle, especially in high winds. The Caquot, with its streamline and smaller envelope, possessed far greater stability, and rode very evenly in much higher winds. The large wind-fed fins succeeded in preventing the rolling common to the other types. Even the Caquot had certain disadvantages, however such as a tendency to nose dive, and a somewhat complicated suspension rigging. It was with the object of obtaining still further improvement that Maj. Avorio, of the Italian Air Service, and Dr. Prassone, Director of the Italian Establishment of Aeronautical Construction, set to work on the design of a new type of kite balloon, and it would appear that their efforts have met with no small amount of success. These A.P. kite balloons were used extensively in the Italian Army, whilst several were also used in this country for the anti-air-raid net barrages. America also had some of these balloons on trial.

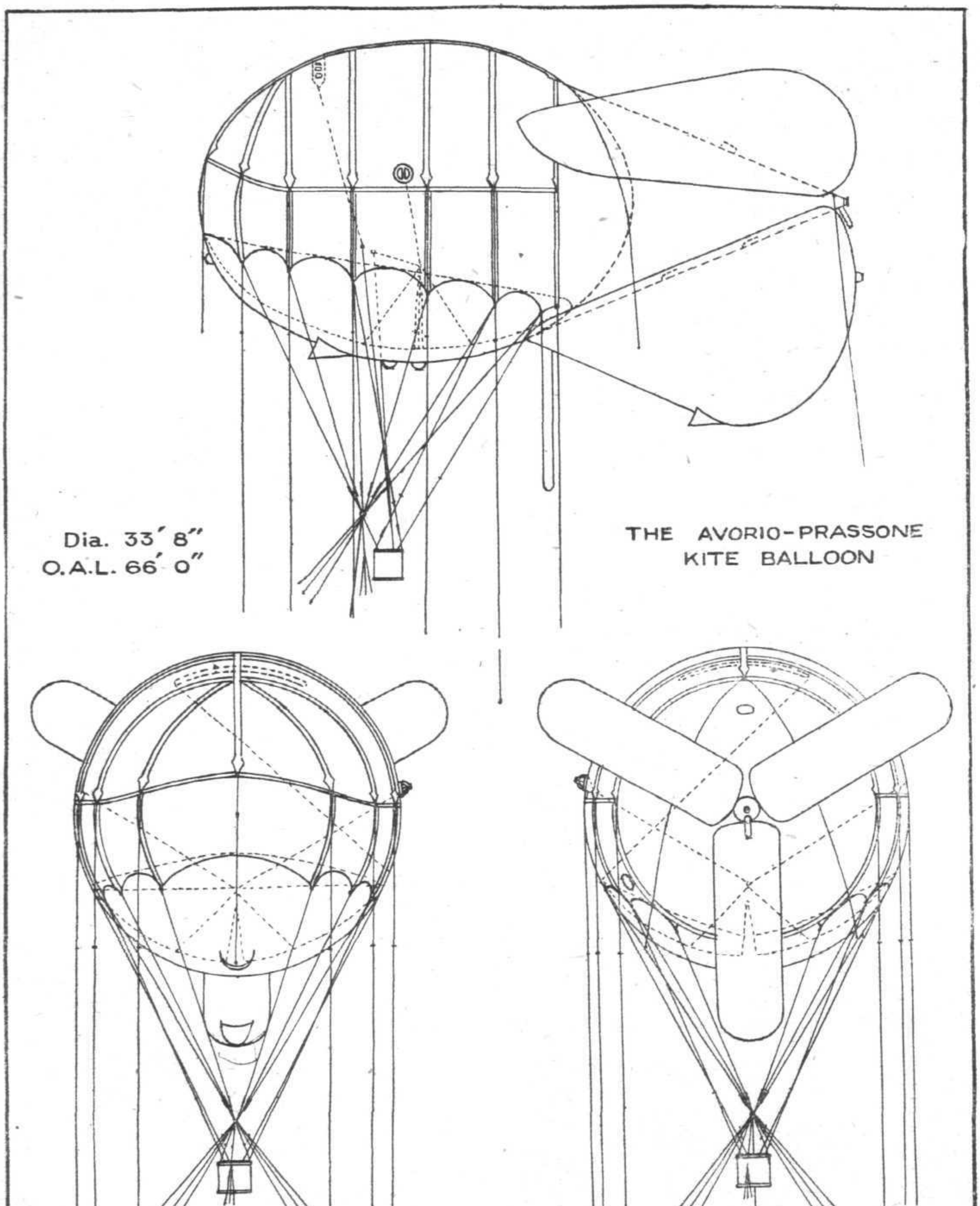
The A.P. kite balloon, whilst retaining the principal characteristics of the Caquot type, also resembles, in a general way, the spherical type. In fact, broadly speaking, the A.P. is a spherical with a Caquot *empennage*. The advantages claimed for the A.P. kite balloon, over other types, may be enumerated as follows: Being almost spherical in shape the gas envelope provides a greater lift for a given weight of envelope, thus producing a smaller and more compact kite balloon as a whole. The suspension is less complicated and requires little, if any, rigging, whilst the basket is slung very close up to the concentration point of the mooring ropes. The balloon rides very easily—almost vertically—even in winds of 50 m.p.h., it does not nose dive, and owing to the smaller surface exposed to the wind yawing is reduced to a minimum. The smaller projected area and the coincidence of the lifting and mooring forces allow a high hauling-down speed. All these features render this kite balloon particularly suitable for sea work; when towed from a ship, although it offers more resistance than the Caquot type, it is much more stable and has a greater lift.

The following is a description of the principal characteristics of the A.P. kite balloon, for which we are indebted to our American contemporary *Aviation*. The gas envelope of the A.P. is ellipsoidal, or ovoidal—according to the model—with the major and minor axes differing only slightly in length. Attached to the rear of the envelope is an air-filled cone, which serves to reduce the wind resistance of the balloon, and, in conjunction with the ballonet, to maintain the shape of the gas envelope. Around this cone there are arranged three air-filled fins, 120 deg. apart.

The winch and basket suspensions are attached to the same points on the envelope, which—in the ellipsoidal model—has the effect of bringing the basket and main cable very close together. The gas envelope is composed of gores, as in the case of airships, and the spherical form is maintained by wide and strong trajectory bands ending at the vertices of the catenaries, thus reinforcing the rigging points. The ballonet seam-line is directly above the catenaries and parallel to a line connecting the terminal rings of the rigging. Therefore, all the outer fabric on the underside of the balloon contains only air. The tension due to the lift and to the action of the wind, on the other hand, is all concentrated in the terminal rings and is transmitted to the cable through the suspension. The catenaries are of steel wire cable 5 mm. diam., having a tensile strength of about 3,960 lbs., while the suspension ropes are of hemp, 12 mm. diam., with a tensile strength of 2,640 lbs. Three-ply cotton fabric, rubberised between the plies, is used



The Avorio-Prassone Kite Balloon: Diagram showing the gas valve gear.



THE AVORIO-PRASSONE KITE BALLOON : Side and end elevations to scale.

for the gas envelope. At the bottom of the gas chamber there is a diaphragm forming the ballonet, into which air is admitted through the scoop at the bottom of the envelope; the ballonet also communicates with the bottom fin through an opening at the forward extremity of the latter, where it joins the envelope. An automatic gas valve, located near the equator of the balloon, is operated by means of small non-stretching metal lines attached to the fabric of the diaphragm. The ripping panel, covering a series of elliptical holes, is on the top of the envelope.

The cone and fins are filled with air, which is admitted through the scoop at the bottom of the lower fin, in addition to the air from the ballonet. Openings between the lower fin and the cone are fitted with fabric valves, allowing air to pass from fin to the cone but not back again. This allows the cone and the upper fins to be inflated by a pump—through an inflation sleeve at the apex of the cone—before the ascent of the balloon, thus obviating swaying at the beginning of the ascent. A fabric release valve, on the top of the cone, is so adjusted that it begins to open at a lower pressure than the gas valve. The expansion of the gas before the gas valve opens expels extra air from the cone and fins at the same time as from the ballonet. Two-ply rubberised fabric of very fine texture is employed for the cone and fins, and instead of the internal rope rigging usually employed on kite balloons, diaphragms, with holes cut in them for the passage of air, extending across the fins, etc., are employed.

The cable suspension consists of twelve ropes, which start from the vertices of the catenaries on the envelope and come together in two groups, each group terminating with a metal ring. The two rings are joined together by means of a ring on a steel rope to which the main cable is attached. Two further rings are also attached to those mentioned above. If the basket is near the cable one of these rings carries the ropes for the central sandbag attachment, and the other takes the two forward suspension ropes of the car; when the basket is located away from the cable—as in the ovoidal model—the sandbag attachment and handling guys are secured to the two rings previously mentioned, the forward basket-suspension ropes running direct to the envelope.

The basket suspension consists of eight hemp ropes from eight of the suspension points of the catenary band. These ropes are attached directly to the basket toggles, and the front and rear ropes criss-cross from one side to the opposite side, thereby preventing side-swinging of the basket. Two middle ropes on each side also criss-cross, the front ropes to the rear of the basket, and the rear ropes to the front. This prevents a fore and aft swinging. With the basket near the cable the two bow ropes are attached to the two rings terminating the cable suspension. The mooring ropes are attached to fourteen patches, connected by a catenary band, on the upper portion of the envelope, on the trajectory bands.

The balloon is inflated through a manometre sleeve, which passes through the ballonet, and as soon as this sleeve begins to fill inflation is stopped.

In order to minimise the risks of fire, due to electric discharges, the valve used in the A.P. balloon is a wooden one of the type used in spherical balloons, suitably modified. The seat is of wood, and the ring is attached directly to the fabric by lacing, thus obviating metal wing nuts. Steel springs are replaced by rubber cords which render the adjustment practically automatic, since each cord passes through a small hole in a wooden cleat fixed to the flat part of the valve. The rubber cords are protected from atmospheric effects by being enclosed in rubber fabric, and fabric also protects the wood of the valve. The envelope is electrically insulated from the basket, and therefore from the earth, by eliminating all metal connections both between the envelope and the basket and the envelope and the mooring cable. Also, by carefully insulating the envelope by covering all hemp suspension ropes with rubberised fabric, and insulating the valve hand-line and rip-line by silk cords. A discharger is also suspended just forward of the valve, and another from the top of the cable. The following are the characteristics of the smallest and largest models of A.P. kite balloons :—

Capacity	26,944 cu. ft.	38,840 cu. ft.
Diameter	33 ft. 8 ins.	37 ft. 6 ins.
Length	44 ft. 3 ins.	59 ft. 0 ins.
Gross lift at 0° C. and 760 mm.	1,984·1 lbs.	2,861·5 lbs.
Net lift at 0° C. and 760 mm.	1,069·3 lbs.	1,763·7 lbs.
Total weight of envelope ..	683·4 lbs.	859·8 lbs.
Weight of mooring lines ..	28·7 lbs.	28·7 lbs.
Weight of cable, suspension complete	39·7 lbs.	46·3 lbs.
Weight of basket suspension	15·4 lbs.	15·4 lbs.
Weight of handling guys ..	66·1 lbs.	66·1 lbs.
Weight of gas valve	11·0 lbs.	11·0 lbs.
Weight of basket	70·5 lbs.	70·5 lbs.
Total weight of balloon ..	914·8 lbs.	1,097·8 lbs.

THE LONDON-CONTINENTAL SERVICES

FLIGHTS BETWEEN NOVEMBER 14 AND NOVEMBER 20, INCLUSIVE

Route	No. of flights*	No. of passengers	No. of flights carrying: Mails	No. of flights carrying: Goods	No. of journeys completed†	Average flying time (h. m.)	Fastest time made by	Type and No. (in brackets) of Machines Flying
Croydon-Paris	14‡	26	2	10	10	3 5	Airco 18 G-EAUF (2h. 18m.)	A.9 (1), A.16 (4), A.18 (1), B. (3), Bt. (1), G. (3).
Paris-Croydon	19‡	24	2	14	17	2 25	Airco 18 G-EAUF (1h. 57m.)	A.9 (2), A.16 (5), A.18 (1), B. (5), Bt. (1), G. (3), H.P. (1).
Cricklewood-Paris ...	5	18	—	2	4	3 40	Airco 4 G-EAVL (2h. 50m.)	A.4 (1), A.9 (1), H.P. (3).
Paris-Cricklewood ...	4	11	—	1	3	2 51	Airco 9 G-EATA (2h. 15m.)	A.9 (2), H.P. (3).
Croydon-Brussels ...	1	—	1	—	1	2 17	Airco 4 O-BALO (2h. 17m.)	A.4 (1).
Brussels-Croydon ...	1	2	—	—	1	2 50	Airco 4 O-BALO (2h. 50m.)	A.4 (1).
Cricklewood-Brussels ...	3	1	3	3	3	2 11	Airco 4 G-EAVL (1h. 48m.)	A.4 (2), A.9 (1).
Brussels-Cricklewood ...	4	—	1	1	3	2 43	Airco 9 G-EAUP (1h. 35m.)	A.4 (2), A.9 (1).
Totals for week ...	51	82	9	31	42			

* Not including "private" flights. † Including certain journeys when stops were made *en route*.
‡ Including certain diverted journeys.

A.4 = Airco 4. A.9 = Airco 9 (etc.). Av. = Avro. B. = Breguet. Br. = Bristol. Bt. = B.A.T. F. = Fokker. Fa. = Farman F.50. G. = Goliath Farman. H.P. = Handley Page. N. = Nieuport. P. = Potez. Sa. = Salmson. Se. = S.E.5. Sp. = Spad. V. = Vickers Vimy. W. = Westland.

The following is a list of firms running services between London and Paris, Brussels, etc., etc. :—Air Post of Banks; Air Transport and Travel; Co. des Grandes Expresses Aériennes; Handley Page Transport, Ltd.; Instone Air Line; Koninklijke Luchtvaart Maatschappij; Messageries Aériennes; Syndicat National pour l'Étude des Transports Aériens; Co. Transaérienne.

The Royal Aero Club of the United Kingdom

OFFICIAL NOTICES TO MEMBERS

COMMITTEE MEETING

A MEETING of the Committee was held on Wednesday last, November 17, 1920, when there were present: Brig.-Gen. Sir Capel Holden, K.C.B., F.R.S., in the Chair, Maj.-Gen. Sir Sefton Brancker, K.C.B., Mr. Ernest C. Bucknall, Lieut.-Col. F. K. McClean, Lieut.-Col. Mervyn O'Gorman, C.B., Group-Capt. C. R. Samson, C.M.G., D.S.O., R.A.F., and the Secretary.

Election of Member.—The following new member was elected :—Sub-Lieut. Edward Cecil Selwyn Savill, R.N.R.

Fédération Aéronautique Internationale.—It was reported that the Bureau of the Fédération Aéronautique Internationale would meet in Paris on January 10 next. It was decided to defer sending in the items for the Agenda until the Joint Standing Committee of the Club and the Society of British Aircraft Constructors had fully considered the proposals for next year's Schneider Race and the Speed Race to replace the Gordon Bennett Race.

The conditions for the Fédération Aéronautique Internationale Superior Brevet were considered.

Classification of Machines.—It was decided that the Racing Committee should formulate the Club's suggestions for the Classification of Machines for racing purposes.

Buc Meeting.—Letter was read from the Aero Club de France thanking the Royal Aero Club for their assistance on the occasion of the Paris–London–Paris Race on October 10, 1920.

Aviators' Certificates.—The following Aviators' Certificates were granted :—

7904. Francis Reginald Alford.
7905. William Richardson Bailey.

Aeronaut's Certificate.—The following Aeronaut's Certificate was granted :—

276. John William Havers.

Airship Pilot's Certificate.—The following Airship Pilot's Certificate was granted :—

66. John William Havers.

Racing Programme 1921

The Joint Standing Committee of the Royal Aero Club and the Society of British Aircraft Constructors meet on Thursday, the 25th inst., to consider the Racing Programme for 1921 and also the Regulations for the Schneider Race.

Servants' Christmas Fund.

The Subscription List for this Fund is now open.

Offices: THE ROYAL AERO CLUB,
3, CLIFFORD STREET, LONDON, W.1.
H. E. PERRIN, Secretary.

NOTICES TO AIRMEN

(124) Aerodrome List Amendments

NOTICE to Airmen No. 106 (Consolidated List of Aerodromes), of October 1, 1920, is amended as follows :—

LIST B (*b*).—*Stations temporarily retained for Service purposes*

The following should be deleted :—

Name.	Seaplane Station Lat.	Long.	Height above sea-level
Killingholme (S) ..	53° 40′ 0″ N.	0° 15′ 0″ W.	—

(S) Seaplane station

LIST C (*b*).—*Civil Aerodromes licensed as "suitable for Avro 504 K and similar types of aircraft only"*

The following should be deleted :—

Name	Aerodrome Lat.	Long.	Height above sea level
Botcherby, Carlisle	54° 53′ 39″ N.	2° 54′ 0″ W.	90 ft.
Bramhall	53° 21′ 0″ N.	2° 11′ 0″ W.	265 ,,
Herne Bay	51° 22′ 0″ N.	1° 8′ 30″ E.	100 ,,
St. Annes-on-Sea ..	53° 46′ 0″ N.	3° 1′ 0″ W.	30 ,,
Taunton, Musgrove Farm	51° 1′ 0″ N.	3° 7′ 0″ W.	60 ,,

(125) France: Nimes Aerial Lighthouse; Toulouse Customs Aerodrome

NOTICE to Airmen No. 98 of September 24, 1920, is amplified as follows :—

Aerodromes

1. NIMES—An aerial lighthouse is now in operation at this aerodrome every day from sunset to one hour after sunset.

It is a white, group, occulting light, whose characteristic is the letter M in morse code, flashed every 10.5 seconds, as follows :—White light, 3.0 secs. ; eclipse, 0.5 sec. ; white light, 3.0 secs. ; eclipse, 4.0 secs.

2. TOULOUSE.—(Lat. 43° 34′ 30″ N., Long. 1° 28′ 30″ E.) is a civil aerodrome owned by M. Latecoere, situated 4 kiloms. (2½ miles) S.S.E. of Toulouse, immediately south-west of the railway to Carcassonne. This ground has been appointed the customs aerodrome for the Toulouse-Casa Blanca Air Service, and it is available for the landing of civil machines in general, provided due notice has been given beforehand to the aerodrome authorities.

This aerodrome should not be confused with the private aerodrome belonging to M. Ernoul, about 3½ kiloms. to the eastward, at Fonsesgrives, Lat. 43° 34′ 30″ N., Long. 1° 30′ 30″ E.

Authority (for para. 1): Bulletin de la Navigation Aérienne No. 7 of October, 1920.

(126) Holland: Aerodromes, Seaplane Stations, Customs, etc.

THE following aerodromes and seaplane stations in Holland have now been made available for civil aviation :—

1. *Aerodromes*

SCHIPHOL. — Civil Customs and Military Aerodrome. *Position.*—Lat. 52° 19′ 0″ N., Long. 4° 48′ 0″ E. Situated 9 kiloms. south-west of Amsterdam, to the west of the Ring Canal, near Schiphol Fort. *Altitude.*—16 ft. *below* sea level. *Landing Area.*—450 × 450 metres. *Accommodation, etc.*—Hangars, petrol, oil and minor repair facilities are available. *Wind Indicator.*—A model of a seaplane, painted orange, in the N.E. corner.

Night Landing Arrangements.—There is no proper lighthouse. The wireless mast in the N.E. corner is illuminated by 76 electric lamps (white) stretching from top to bottom of the mast. These lights are at present only in operation by special request to the Commandant of the Aerodrome and at such other times as deemed expedient by the Commandant. The height of the mast is 41 metres (135 ft.).

Customs.—Schiphol is a regular Customs station, but in the case of machines not landing at scheduled times the aerodrome authorities must be notified beforehand of the intended time of arrival, otherwise the machines cannot be cleared immediately upon arrival.

SOESTERBERG.—Civil and Military aerodrome. *Position.*—Lat. 52° 8′ 0″ N., Long. 5° 17′ 0″ E. Situated 8 kiloms. W.S.W. of Amersfoort, 1 kilom. south of the Amersfoort-Utrecht railway. *Altitude.*—Approximately 150 ft. above sea level. *Landing Area.*—Approximately 1,200 × 800 metres. *Markings.*—Two orange-coloured circles are displayed on the aerodrome. The wind indicator is placed in the middle of the aerodrome. *Accommodation, Supplies, etc.*—Hangars, petrol, oil and all facilities for repairs are available.

Obstructions.—Trees surround the aerodrome. Hangars and sheds are situated on the east side of the aerodrome, and outside the eastern boundary there is a wireless mast situated on a hill, the mast rising to a height of about 170 ft. above the level of the aerodrome.

Lighthouse, Night Landing Arrangements, etc.—Landing lights are installed. On top of the wireless mast, at a height of 50 metres (170 ft. approximately) above the aerodrome, an aerial lighthouse in the form of a revolving searchlight has been installed. The colour of the light is white. The beam is concentrated in a horizontal plane, and revolves once in every 2 secs. After every two revolutions there is an eclipse of 4 secs. The light is visible over the whole horizon. The appearance of the light is thus approximately as follows :—White flash, eclipse, 2 secs. ; white flash, eclipse, 6 secs. The

wireless mast itself is illuminated by a row of electric lamps. The lighthouse and lights on the wireless mast are only lit by special request to the Commandant, and at such other times as deemed expedient by the Commandant.

Customs.—A machine cannot ordinarily be cleared by the Customs authorities at this aerodrome, but arrangements may be made for Customs examination by obtaining permission from the Commandant prior to arrival. In this case the Commandant will notify the Customs authorities. Normally, machines should proceed to Schiphol.

DE KOOY.—Civil and Naval aerodrome. *Position.*—Lat. 52° 54′ 30″ N., Long. 4° 47′ 0″ E. Situated about 7 kiloms. S.S.E. of Den Helder, to the east of the railway line. *Altitude.*—Practically at sea level. *Landing Area.*—Approximately 800 × 800 metres. *Markings.*—The wind indicator is displayed on a hangar in the N.E. corner of the aerodrome.

Obstructions.—The hangars are arranged along the north and east sides in the north-east corner. At a distance of about 100 metres from the eastern boundary is the dyke of the Zuider Zee rising to a height of about 30 ft.

Accommodation, Supplies, etc.—Hangars and repair facilities on the aerodrome. Petrol and oil are stored for military use, and are not normally available for civil machines.

Night Landing Arrangements.—The hangars are lit by obstruction lights at night. There is no aerial lighthouse, but at a distance of 6 kiloms. to the N.W. is the lighthouse of Kijkduin (S.W. of Den Helder), whose characteristics are: White group flashing light of 1,200,000 C.P.; height 187 ft.; visible 20 miles in clear weather all round the horizon; giving two flashes every 10 secs. as follows:—Flash, ¼ sec.; eclipse, 1¾ sec.; flash, ¼ sec.; eclipse, 7¾ secs.

Customs.—There are no Customs facilities at this aerodrome, which is open to civil aviation, but not to international traffic.

2. *Seaplane Stations*

SCHELLINGWOUDE.—Civil and Naval seaplane station.—*Position.*—Lat. 52° 22′ 30″ N., Long. 4° 58′ 0″ E. Situated about 4 kiloms. E. by N. of Amsterdam immediately south of the village of Schellingwoude. *Markings.*—A wind indicator is on the roof of the shed. *Accommodation, Supplies, etc.*—There is one hangar. Petrol and oil and minor repair facilities are available.

Night Landing Arrangements.—The pier stretching to the east from the station is illuminated by a row of lights, which form a good landmark at night. At the eastern end of the pier is a fixed light showing red and green, and at the opposite (northern) side of the entrance to the harbour is a white occulting light, period 5 secs., visible for 10 miles.

Customs.—This is a regular Customs station, but in the case of machines not arriving at scheduled times the authorities at the station must be warned beforehand of the intended time of arrival, otherwise the machines cannot be cleared immediately on arrival.

DE MOK.—Civil and Naval seaplane station.—*Position.*—Lat. 53° 0′ 0″ N., Long. 4° 45′ 30″ E. Situated on the south end of the Isle of Texel, about 3 kiloms. S.S.E. of the village of Hoorn. *Landing Area.*—Machines should land in the open sea and taxi to the station, the channel, on either side of which is shallow water with a silt bottom, being marked by buoys on the southern side. *Markings.*—The wind indicator is in the form of a flag on the corner of the hangar. A landing T is also displayed. *Accommodation, Supplies, etc.*—There is one slipway. Hangars and repair facilities are available. Petrol and oil are stored for the use of the station, and are not normally available for civil machines.

Night-Landing Arrangements.—A good landmark at night is provided by the two lighthouses Schilbolsnol and Stuifdijk, situated at the head of the inlet at De Mok, about 1 kilom. from the seaplane station, in a line bearing approximately N.E. and S.W. The former is to the N.E. and is a fixed white light of 450 c.p. at a height of 91 ft., visible for 13 miles, the latter being a white light of 450 c.p. at a height of 29 ft., occulting every 5 secs., the eclipse being 1½ secs. This is visible for 10 miles. These lights are only visible through an arc of 16°, from 200° to 216°. The entrance to the channel mentioned above is illuminated by a light-buoy.

Customs.—There are no Customs facilities at this station. Machines should proceed to Schellingwoude for clearance.

OTHER AERODROMES.—The aerodromes at *Gilze Rijen* and *Souburg* (Flushing) and the seaplane station at *Veere* are not open to civil aviation.

3. *Customs*

The Customs facilities provided at each station are shown under their respective headings above. The *only* customs stations are the following:—*Regular Customs Stations.*—Schiphol aerodrome, Schellingwoude seaplane station. *Station at which clearance can only be effectel by special arrangement.*—Soesterberg aerodrome.

4. *Dangerous Areas*

In view of the danger to low flying aircraft caused by wireless masts, the Dutch Government (Minister of " Waterstaat ") has issued a notice giving the positions of the following wireless stations:—

SCHEVENINGEN HARBOUR.—Two masts, height 100 metres (approximately 330 ft.), situated in Lat. 52° 6′ N., Long. 4° 15′ E. (approx.).

SAMBEEK.—Seven masts in a line approximately east-west, height 60 metres (approximately 200 ft.). The length of the whole system is 1,800 metres. The centre mast is situated in Lat. 51° 36′ N., Long. 5° 56′ E. (approx.).

KOOTWIJK.—Six masts, one in the centre, and the other five forming five angles of a regular pentagon with a radius of 450 metres, height 210 metres (approximately 690 ft.). The centre mast is situated in Lat. 52° 10′ N., Long. 5° 50′ E. (approx.). Aircraft should avoid flying low in the neighbourhood of these stations.

5. *Prohibited Area.*—*See* Notice to Airmen No. 77 of 1920.

6. *Wireless Procedure.*—*See* Notice to Airmen No. 123 of 1920.

7. *Authority.*—Dutch Notices to Airmen Nos. 2 and 3; Notices by the Dutch Minister of " Waterstaat."

8. *Cancellation.*—Notice to Airmen No. 71 of 1920 is hereby cancelled.

(127) Penshurst Landing Ground: Provision of Wind Indicator

A LINEN wind indicator is installed on the emergency landing ground at Penshurst: Lat. 51° 12′ N., Long. 0° 11′ E. (List B (*c*) of Consolidated list of Aerodromes for Civil use: Notice to Airmen No. 106 of 1920.)

This indicator is cone-shaped, painted with black and red bands, and attached to a mast erected on the hangar at the southern side of the landing ground.

(128) Biggin Hill Aerodrome: Obstructions

1. PILOTS are warned that sheep graze on the aerodrome at Biggin Hill on week-days before 0900 hours and after 1700 hours, and during the week-end uninterruptedly.

2. As, in misty weather, aircraft have been observed to cross the aerodrome at very low altitudes, attention is drawn to the fact that the two wireless masts ¾ mile S.S.E. of the aerodrome are 120 ft. high and have an aerial between them.

(129) Manchester Aerodrome: Obstructions

PILOTS intending to land at Manchester Aerodrome (Lat. 53° 26′ 0″ N., Long. 2° 15′ 0″ W.) are warned that the grazing has been let for the winter months, and therefore that they may expect to find cattle and sheep on the aerodrome.

Army Officers for the R.A.F.

IT is understood that arrangements have now been concluded between the War Office and the Air Ministry by which selected young Army officers will be seconded for four years to the R.A.F., while a number of R.A.F. officers will be seconded for service with the Army. A few Army officers have recently been attached to the R.A.F., but the first batch of 30 young officers to come under the scheme will be seconded in March of next year. They will be given temporary R.A.F. commissions, and their R.A.F. service will count toward pension.

Germany Refuses to Deliver More Zeppelins

FROM a message to hand from Berlin, it appears that the demand of the Ambassadors' Conference for the surrender of two further Zeppelins—The " Bodensee " and the " Nordstern "—as a compensation for the two destroyed German airships is being resisted, as is also the claim for a monetary compensation for the other destroyed airships. In pleading that these demands are quite unjustified, Germany tries to make out that all Entente claims on Germany in respect of alleged violations of the terms of the Armistice have been settled under the Scapa Flow protocol.

German Services Suspended

IT has been decided that the German aerial services connecting Amsterdam, Bremen, Hamburg and Copenhagen and Berlin, Warnemunde, Malmoe and Copenhagen shall be suspended during the winter months. The present intention is to resume these services in March next. The service between Berlin and Bremen is to be maintained during the winter.

A STUDY OF AEROPLANE RANGES AND USEFUL LOADS

BY J. G. COFFIN

(*Concluded from page* 1201)

PART III. Effect of Wind on Range Calculations

Best Flight Speed.

IF there is a retarding or a helping wind it will be shown below that the conditions for maximum range must be changed.

The following is a proof of an important method for finding the proper attitude of flight with or without winds.

Let curve I be the required thrust-speed curve and II the required power-speed curve for the machine.

Consider a machine of constant weight W which is flying with air speed V against a wind speed w. The ground speed is then $V - w$.

In order to fly a *ground* distance ds it will take a time $dt = \frac{ds}{V - w}$.

If the thrust is T and "a" is the rate of gas consumption per *delivered* power the gas consumed in flying this distance is

$$aPdt = aP\frac{ds}{V - w}. \qquad (30)$$

As "a" is assumed constant and ds is fixed, for this expression to be a minimum we must have

$$\frac{d}{dV}\frac{P}{V - w} = O = \frac{(V - w)\ P' - P}{(V - w)^2}$$

and since $V - w$ cannot be infinite the condition is:

$$P' = \frac{P}{V - w}.$$

This means that the subtangent to the power-speed curve is $(V - w)$ and the equation is fulfilled by the following construction: Lay off w, figure 9, on the V-axis, to the right of the origin, if a contrary wind, or to the left if a following wind, and draw a tangent from this point to the $P - V$ curve; it is seen that the slope or tangent P' is equal to $\frac{P}{V - w}$. For calm air the tangent is drawn from the origin. As the slope of a line drawn from the *origin* to any point on the $P - V$ curve is always $\frac{P}{V} = \frac{VT}{V} = T$, it follows that the thrust varies as the slope of such a line, and as the tangent from the origin to the $P - V$ curve has evidently the minimum slope, this shows that in calm air the machine must fly at minimum thrust, as is otherwise evident.

Thus the minimum points of the $T - V$ curves lie directly over the points of tangency of lines from the origin to the $P - V$ curves.

If there is a head wind this condition of minimum thrust no longer holds, and more power is required for most economic flight, which corresponds, of course, to a greater thrust.

As the power curve is limited to the right by the maximum output of the power plant, it is seen that for *economical* flight there is a limiting head wind corresponding to the distance OH, where H is the intersection of the tangent to the $P - V$ curve at its limit with the V-axis. It is, of course, possible to make headway against stronger winds, but the condition for economical flight in such a case is no longer fulfilled. When w is a helping wind the tangent is drawn from a point on the left of O, and it is evident that as the following wind increases in speed it pays to use less and less power, the limit for an infinite wind being minimum power. In other words, it pays to let the wind carry the machine along with the least use of the power plant. Curiously enough, this corresponds to a thrust greater than the minimum which is proper in calm air.

While for economic flight in calm air the machine must fly at minimum thrust, and hence at maximum L/D* for the machine for all loads, this simplicity does not obtain for economic flight in the wind. Not only does the L/D change for a given load with varying winds, but also for a constant wind it varies with the load. Fortunately these variations are small for any reasonable head winds and for a change of load equal to the weight of the machine empty. Referring to figure 9, the proper L/D's for the machine, and hence the proper angles of incidence, may be determined by the method demonstrated above.

Assuming a head wind of w miles per hour, draw tangents to the required horsepower curves from abscissa $+w$. Read off on the thrust curves the thrusts corresponding to the points of tangency on the power curves, divide these thrusts by the corresponding weight of the machine, and the values thus obtained are the D/L's corresponding to economical flight under the assumed conditions.

Single Curve Method.

A much simpler method will now be described to accomplish the same result requiring the drawing of but a single curve for the whole procedure.

The method is based upon the following considerations:

The equations for horizontal flight may be written

$$W = LAV^2$$
$$T = DAV^2$$
$$P = TV$$

From these we obtain
$$V = \frac{1}{\sqrt{LA}} \cdot W^{1/2}. \qquad (31)$$
$$T = \frac{D}{L} \cdot W. \qquad (32)$$
$$P = \frac{1}{\sqrt{LA}} \cdot \frac{D}{L} W^{3/2}. \qquad (33)$$

These equations show that as the load changes the corresponding speeds for any given angle of incidence vary as $W^{1/2}$, the thrusts as W and the powers as $W^{3/2}$.

Consider now any required power-speed curve. Fig. (9).

The required power curves for any other weight W_1 can be calculated from this given curve by multiplying the speeds by $\left(\frac{W_1}{W}\right)^{1/2} = \lambda^{1/2}$ and the corresponding powers by $\left(\frac{W_1}{W}\right)^{3/2} = \lambda^{3/2}$ and plotting these values on the same sheet. If required the thrust curves can be obtained by plotting $\frac{P\lambda^{3/2}}{V\lambda^{1/2}} = \frac{P}{V}\lambda$ against $V^{1/2}$.

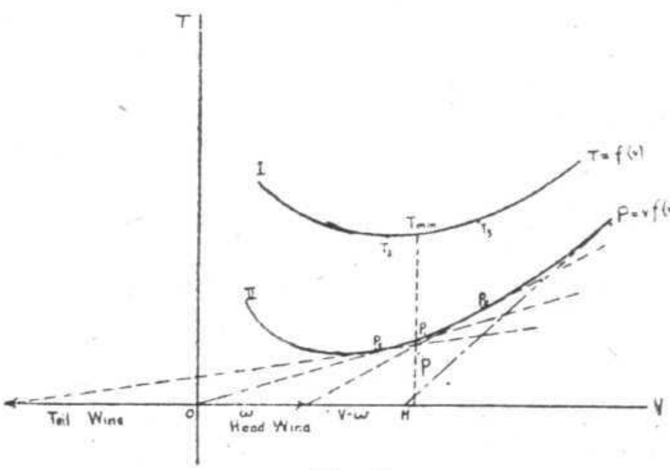


Fig. 9

Consider what effect a change in loading has upon the equation of condition for economical flight.

$$\frac{dP}{dV} = \frac{P}{V - w}$$

becomes for a new loading W_1

$$\frac{dP \cdot \lambda^{3/2}}{dV \cdot \lambda^{1/2}} = \frac{P\lambda^{3/2}}{V\lambda^{1/2} - w}$$

where
$$\lambda = \frac{W_1}{W}$$

This reduces to
$$\left(\frac{dP}{dV}\right) = \frac{P}{V - \frac{w}{\lambda^{1/2}}} \qquad (34)$$

which indicates that instead of plotting $P - V$ curves for various loads and drawing tangents from the abscissa w it is sufficient to plot but one curve, and as the load increases draw tangents from abscissas $\frac{w}{\lambda^{1/2}}$ as the *load* changes. The point of tangency determines values of P and V which correspond to a required power $P\lambda^{3/2}$ and a flying speed $V\lambda^{1/2}$ for the new condition.

As the main interest here is to find the variations in L/D, or, what is the same thing, in D/L, we continue as follows:

Since $\frac{P\lambda^{3/2}}{V\lambda^{1/2}} = \frac{P\lambda}{V}$ is the new corresponding thrust, and

* In the following D represents the total drag on the machine and corresponds to $(D + R)$ in the preceding pages.

since the new thrust divided by the new load W_1 gives the new D/L, it is seen that

$$\frac{\frac{P}{V^{\lambda}}}{W_1} = \frac{T\lambda}{W_1} = \frac{T}{W} = \left(\frac{D}{L}\right)_1 \qquad (35)$$

and hence in order to determine the D/L for any new loading it is merely necessary to draw a tangent from $\frac{w}{\lambda^{1/2}}$, and the ratio $\frac{P}{V}$ read off on the *original* scale is the corresponding value of the $\frac{D}{L}$ required.

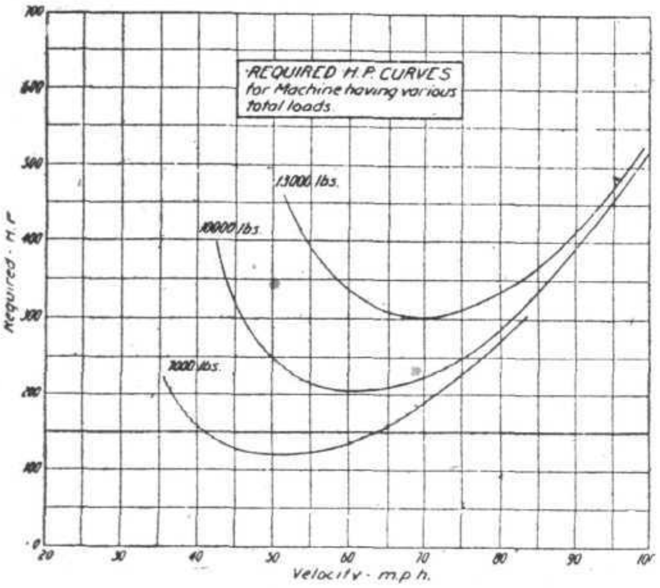


Fig. 10

This single curve is preferably ploted for some simple load such as 1,000 pounds or 10,000 pounds. The D/L's will then come out directly by dividing the power by the speed, and by changing the position of the decimal point.

Example of Use of the One-Curve Method.

In order to check the proposed method against the usual multicurve method, three P–V curves were plotted for the same machine with loads of 7,000 lbs., 10,000 lbs. and 13,000 lbs. respectively. The machine weighs 7,000 lbs. empty.

These curves are shown in Fig. (10). The L/D's for various wind speeds were derived from them and compared with the L/D's taken from the 10,000-lb. curve using modified wind speeds as described above.

The agreement is very satisfactory, as shown in the table (6) below.

When using the curve for a 7,000-lb. load the modified wind speeds corresponding to w are

$$w\sqrt{\frac{10}{7}} = 1\cdot195\,w,$$

and for a load of 13,000 lbs. they are

$$w\sqrt{\frac{10}{13}} = \cdot877\,w.$$

TABLE (6).

Actual wind speeds, w, in miles per hour	L/D from 7,000-lb. P–V curve	L/D from 10,000-lb. P–V curve (7,000 lbs.)	Modified wind speeds used, $1\cdot195\,w$	L/D direct from 10,000-lb. curve (10,000 lbs.)	L/D from 13,000-lb. P–V curve	L/D from 10,000-lb. P–V curve (13,000 lbs.)	Modified wind speeds used, $0\cdot877\,w$.
−40	8·26	8·31	−47·80	8·31	8·35	8·33	−35·06
−20	8·35	8·37	−23·90	8·35	8·38	8·40	−17·53
0	8·41	8·43	0	8·44	8·43	8·43	0
10	8·41	8·43	11·95	8·41	8·41	8·42	8·77
20	8·29	8·31	23·90	8·32	8·41	8·42	17·53
30	8·04	8·03	35·85	8·19	8·25	8·25	26·60
40	7·47	7·45	47·80	7·96	8·04	8·07	35·06
50	5·95	5·90	59·75	7·21	7·62	7·60	43·82

Several interesting results appear from the values obtained.

1. The influence of wind on the L/D is greater for light loads than for heavy. A change in L/D from 8·43 to 5·90 is found for the 7,000-lb. machine as against a change from 8·43 to 7·60 for the 13,000-lb. machine, these values corresponding to a change in head-wind speed of 50 miles per hour.

2. This influence still holds although much less noticeably for helping winds, the L/D changing from 8·43 to 8·30 for the light machine as against 8·43 to 8·34 for the heavy machine.

3. For any reasonable head wind that could be flown against in long-distance flight, the change in the L/D is small, running from 8·43 to 8·00 for the 7,000-lb. case to 8·43 to 8·25 for the 13,000-lb. case, these values corresponding to a head wind of 0 and 30 miles per hour, respectively.

As practically it is difficult to fly at a given angle with mathematical accuracy the main result of these figures is to show that as the head winds increase in speed it is necessary to slightly diminish the flying angle; exactly how much depending on a preliminary calculation as outlined above.

The instructions to the pilot can be given in either of two ways:

(*a*) Proper flying angles for any given wind.
(*b*) Proper air speed for any given wind.

A plot of the values of L/D against wind speeds for the three loadings is shown in Fig. (11). These L/D values correspond to definite air speeds at a given altitude and definite angles of incidence which can also be placed upon the plot. Such a chart will give with sufficient exactness the proper flying angles for practical navigation under economical conditions.

Range Formulæ including Effect of Winds.

The time-weight equation (13)

$$t = \frac{2}{K}\left(\frac{1}{\sqrt{W}} - \frac{1}{\sqrt{W_f}}\right)$$

where

$$K = \frac{a}{\sqrt{\gamma}}\,\frac{C_2}{C_1^{3/2}}$$

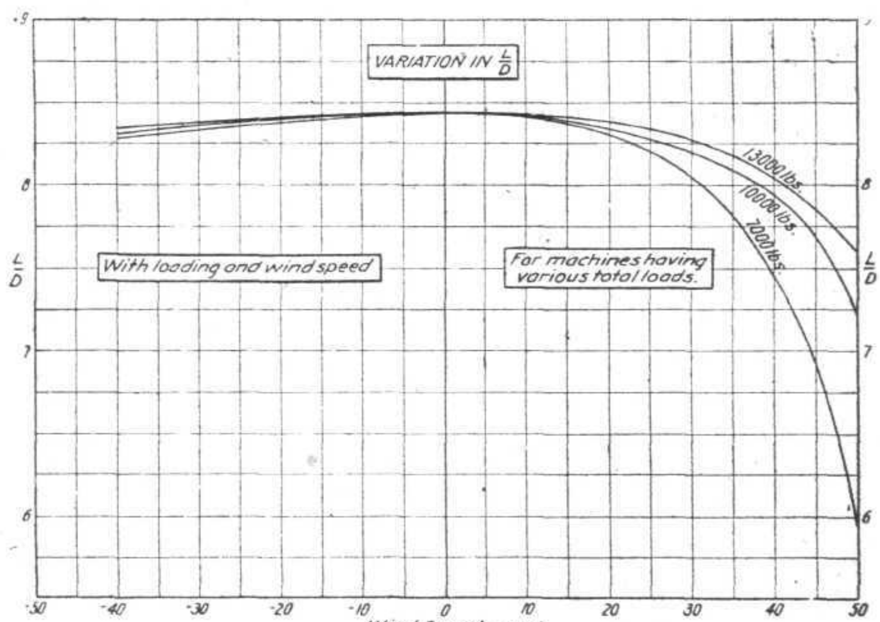


Fig. 11

is naturally unchanged, since for a given angle of incidence the *time* in which the fuel is consumed cannot depend on whether there is a wind or not.

The time-distance equation must be modified. Since the ground distance is the important factor the wind modifies the range. If at any instant the air-speed is V and the wind speed w, the ground speed is $V - w$, and in time dt a ground distance

$$dS = (V - w)dt \qquad (36)$$

will be covered. With an obvious substitution, this becomes

$$dS = \sqrt{\frac{W}{C_1\gamma}}\,dt - w\,dt$$

and

$$S = \frac{1}{\sqrt{C_1\gamma}}\int_0^t W^{1/2}\,dt - \int_0^t w\,dt.$$

Using equation (13) this becomes

$$S = \frac{1}{\sqrt{C_1\gamma}}\frac{2}{K}\int_0^t \frac{\frac{K}{2}\,dt}{\frac{K}{2}t + \frac{1}{\sqrt{W_f}}} - w\int_0^t dt$$

$$= \frac{2}{K}\frac{1}{\sqrt{C_1\gamma}}\log_e\left(\frac{K}{2}t + \frac{1}{\sqrt{W_f}}\right) - wt + \log C.$$

The constant of integration log C is determined by the condition that when $t = O$ $S = O$ and

$$\log C = -\frac{2}{K}\frac{1}{\sqrt{C_1\gamma}}\log_e\frac{1}{\sqrt{W_f}}$$

so that finally $$S = \frac{2}{K}\frac{1}{\sqrt{C_1\gamma}}\log_e\frac{\frac{K}{2}t + \frac{1}{\sqrt{W_f}}}{\frac{1}{\sqrt{W_f}}} - wt.$$

Eliminating t and giving K its value we have

$$S = \frac{1}{a}\left(\frac{L}{D}\right)\log\frac{W_f}{W} - \frac{2}{a}\left(\frac{L}{D}\right)\sqrt{\gamma LA}\left(\frac{1}{\sqrt{W}} - \frac{1}{\sqrt{W_f}}\right)w \quad (37)$$

The L/D which appears in this equation is an average value given by the preliminary calculation as in Table (6) corresponding to loads and wind speeds for which the range is desired.

It would, of course, be possible to introduce an empirical expression for L/D in terms of W which could be integrated, but no practical advantage would accrue on account of the impossibility of obeying the mathematically exact conditions in actual flight.

The expression (31) for S can be put into either of the following forms by simple transformations:

$$S = \frac{1}{a}\left(\frac{L}{D}\right)\log\frac{W_f}{W} - \frac{2}{a}\left(\frac{L}{D}\right)\left(\frac{1}{V} - \frac{1}{V_f}\right)w$$

$$= \frac{1}{a}\left(\frac{L}{D}\right)\log\frac{W_f}{W} - wt$$

$$= \frac{2}{a}\left(\frac{L}{D}\right)\left[\log\frac{V_f}{V} - w\left(\frac{1}{V} - \frac{1}{V_f}\right)\right]$$

$$= \frac{1}{a}\left(\frac{L}{D}\right)\log\frac{W_f}{W} - \frac{2}{a}w\left(\frac{W}{P} - \frac{W_f}{P_f}\right)$$

In all of these expressions the altitude of flight is assumed to be substantially constant.

Summary.

The relation between useful load and range has been worked out by two distinct methods.

Part I employs no new theory, and is made by the usual performance estimate methods. It would involve considerable plotting of curves and is cumbersome.

Part II gives a theoretical solution. This solution checks remarkably well with the previous one in every particular. It leads to an elegant and simple solution for any specific case.

Directions are given for the application of the results of this paper to any machine. The total time required for this complete calculation should not take over 15 minutes.

The results of interest for calm air are:

1. The machine should fly at a constant angle of attack, the angle corresponding to the minimum value of $\frac{\text{Weight}}{\text{Total resistance}}$.

2. It is practically immaterial whether the machine flies high or low as far as range is concerned.

3. There is an advantage in flying high in that the time is much reduced.

4. The resistance is proportional to the weight at a given altitude.

5. The result of flying at maximum speed is a very much diminished range, or for a given range a very much diminished useful load.

6. The result of flying at minimum power is to slightly reduce the range.

7. The times of flight at the same level for flying at best range speed and at minimum power speed are practically the same.

8. The condition for best range is shown.

9. The weight-time curve is deduced.

10. The range-time curve is deduced.

11. The weight-range curve is deduced.

12. The effect of altitude has been taken into account.

13. The time is greatly diminished for flying at corresponding levels.

14. The theory checks closely with the ordinary methods of Part I.

Part III gives a theoretical solution of the effect of wind on range. First, a proof of a method for determining the L/D and air speed for the machine under any wind conditions is given. A new method is shown wherein but one P – V curve is required for any load and any wind speed.

Variations in L/D for changes in load and wind speed are derived and checked against the usual methods.

The weight-distance formula is derived as modified by winds.

The results of interest for flight in winds are:

1. The angle of attack changes but slightly when flying against winds of reasonable strength, and but very slightly when flying with winds of any strength.

2. The altitude of flight affects the range. The reason being that higher speeds are attained at higher altitudes and the ratio of air speed to wind speed changes. However, as wind speeds change with altitude it does not seem worth while to go into the matter more fully.

3. Other things being equal, it is slightly advantageous to fly high, especially as to time of flight.

4. The weight-time curve is unchanged.

5. The range-time curve is deduced.

6. The weight-range curve is deduced.

ROYAL AERONAUTICAL SOCIETY NOTICES

Lectures.—The next meeting of the Society will take place on Thursday, December 2, at 5.30 p.m., at the Royal Society of Arts, John Street, Adelphi, when Air-Marshal Sir Hugh Trenchard, K.C.B., D.S.O., will take the Chair. Abstracts of two papers will be read: "Airship Piloting" by Major G. H. Scott, C.B.E., A.F.C., and "Airship Mooring" by Flight-Lieut. F. L. C. Butcher, R.A.F.

The following meeting will be on December 16, when Mr. H. Ricardo will read an abstract of his paper on "Possible Developments in Aircraft Engines," to be followed by a paper by Mr. A. J. Rowledge on "The Installation of Aeroplane Engines."

Annual Dinner.—At the Annual Dinner held at the Connaught Rooms on November 17, 137 Members and Guests were present. After the Royal toasts the Marquess of Londonderry, K.G., Under-Secretary of State for Air, proposed "The Royal Aeronautical Society," to which the Right Honourable the Lord Weir of Eastwood, President, responded. The toast of "The Guests" was proposed by Maj.-Gen. Sir R. M. Ruck, K.B.E., C.M.G., Sir Alfred Keogh responding.

Examinations Committee.—The regulations for the examination of applications for Associate Fellowship prepared by the Examinations Committee were approved by the Council at their meeting on November 16, and the Committee is now proceeding with the drawing up of a syllabus.

Election of Members.—The following Members were elected in the various grades as shown:—*Associate Fellows:* Squad.-Leader J. T. Babington, D.S.O., Air Vice-Marshal Sir E. L. Ellington, K.C.B., C.M.G., C.B.E., Lieut.-Col. V. C. Richmond, O.B.E., and W. Sydney Smith, Esq., B.Sc. *Students:* N. Comper, Esq., Flying Officer C. J. Sims. *Members:* Wing-Comdr. M. G. Christie, C.M.G., D.S.O., M.C., Flight-Lieut. O. Vickers. *Foreign Members:* C. L. Egtvedt, Esq.

Scottish Branch Elections:—*Associate Fellows.*—J. L. Bartlett, Esq., A. J. Campbell, Esq.

Vice-President.—At the Council Meeting held on November 16 Major-General Sir R. M. Ruck, K.B.E., C.M.G., was elected a Vice-President, in recognition of his valuable work on the Society's behalf over a period of many years, during eight of which he occupied the Chair.

W. LOCKWOOD MARSH, Secretary

R.A.F. Employés in the T.F.

THE Army Council has decided that the enlistment of civilian employés of the R.A.F. in the Territorial Army will be limited to 2 per cent. of the total number of the civilian subordinates employed in any unit, stores depôt, or directorate of works and buildings of the R.A.F. Such men will only be permitted to enlist in the T.F. Royal Corps of Signals, R.E., R.A.S.C., and R.A.O.C.

AIRISMS FROM THE FOUR WINDS

STILL more progress in wireless. Messages are being received at the Aldershot War Office wireless station from Cologne Headquarters at a regular speed of 100 words a minute. The messages are now able to be automatically printed in usual typewriter characters, all transcriptions of Morse characters being eliminated. Mr. Creed, whose well-known Morse-recording and typing apparatus was used in conjunction with Army pattern instruments, assisted at a recent demonstration of this achievement at Aldershot, and, needless to say, representatives of the R.A.F. were not the least interested of those who witnessed the remarkable results.

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L'Opinion has noted the introduction of a motor-cycle engine into the orchestration of the music of the new futurist opera "Airman Dro," produced recently at Lugo and referred to in these columns the other week. Our Paris contemporary places the rôle of the engine as "reproducing the drone of an aeroplane propeller." Funny sort of propeller, we fancy.

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MORE air-post stamps are appearing. Rumania is responsible for the latest effort in this direction. She has issued two separate series in connection with the newly-established air-post service. The first, in very restricted numbers, consists of various current and obsolete postage stamps overprinted "P.A.R." (Posta Aeriana Romana) and surcharged with the new values of two, five, and ten lei. The second series, comprising 5,000 sets of five and ten lei stamps, only bears the inscription "Posta Aeriana, 1920," overprinted in a double-lined rectangle.

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THE free port of Dantzig comes into line with three more air-post stamps, extemporised by overprinting the device of a biplane in flight, or, alternatively, a winged post-horn, on the new German 40 pfg. postage stamp, whilst for the Siamese air-post service a special overprint, extending over a block of four stamps, is employed. It contains, within a rectangular frame, the Royal emblem of the mythological Garuda bird.

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IN connection with air-post stamps, quite an excellent suggestion is made, in the course of a general article upon these issues, by Mr. F. J. Melville in the *Daily Telegraph*. His idea is that in these days when stamp collecting offers so vast a field that none would venture to embark upon a collection of all the world's postage stamps, it is as well that the pastime lends itself to sectional and specialised treatment. To the new devotee it is possible to start a special collection on equal terms with the collector of long experience. Such an opportunity is afforded today, he suggests, by the slow but steady development of the aero postage stamp. There are just forty distinct varieties (apart from errors and minor varieties) of air-post stamps available so far, and all but two of them are at present easily accessible. Thus the man who embarks upon a collection of aero stamps to-day has a comparatively small task to bring his possessions up to date, and if he keeps pace with successive issues, he will have in his aero stamps an interesting, historical, and ultimately valuable record of the growth of the aerial mail.

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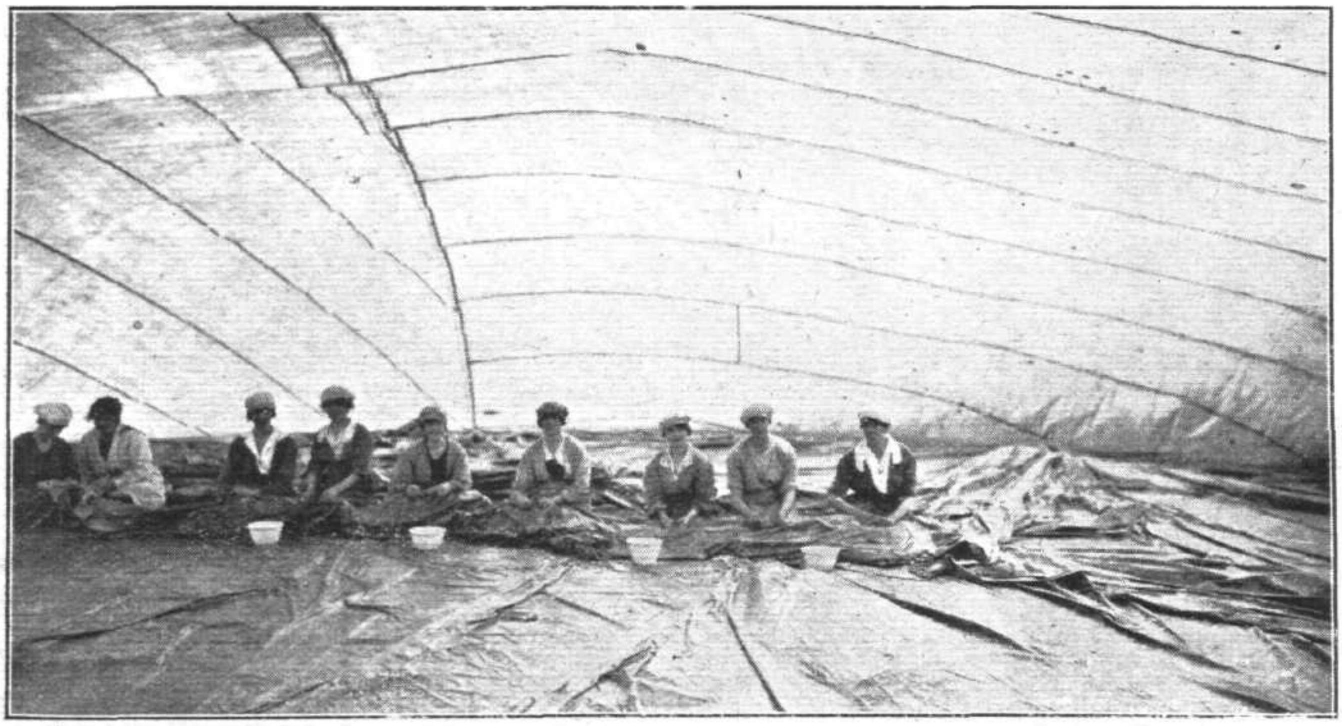
AN illustrated lecture on "Women and Flying" is to be given on December 3 in aid of the Great Northern Hospital, in the Lecture Hall of the Upper Holloway Baptist Church (near the Hospital) by Miss Mary Abbott, London woman editor of the *Sheffield Independent* and its associated papers. Miss Abbott is no novice at flying and her experiences and views should prove particularly interesting, as she is likely to treat the subject in a popular vein. Miss Abbott made her first flight in April, 1914 (up the Loxley Valley from Sheffield), in a monoplane with Mr. (now Major) Harold Blackburn, some 40,000 people witnessing it. In July, 1919, she went up at Coalaston with Capt. R. F. C. Broome, one of the pilots who subsequently took the Vickers-Vimy-Rolls aeroplane, with Dr. Chalmers-Mitchell aboard, on the Cairo to the Cape aerial expedition. In September, 1919, she went to Doncaster Races by aeroplane, Capt. Woolley-Dod, pilot. Miss Abbott attended the first aviation meeting held in England at Doncaster in October, 1909, and since then has been constantly writing about aviation, her articles on flying having been extensively published.



INSIDE A GIANT AIRSHIP GASBAG: A photograph taken at the Inchinnan Airship Construction Works of Messrs. William Beardmore and Co., Ltd., showing women workers engaged in rectifying and touching up the fabric inside one of the giant gasbags which this firm is making for the "R. 38." This is one of the largest bags Messrs. Wm. Beardmore, who are builders of "R. 34," have ever made; it measures over 80 ft. in diameter. After the fabric has been skin-lined in panels, it is assembled into a complete unit, and then has to be inflated on the floor with hot air so that a scrutiny of all joints and fittings may be made inside.

CORRESPONDENCE

The Editor does not hold himself responsible for opinions expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters intended for insertion in these columns

THE PRESENT AND FUTURE CIVILIAN PILOT.

[2035] During the discussion following the reading of Squadron-Leader Roderick Hill's paper on "The Flying of Single and Twin Engined Aircraft" before the Royal Aeronautical Society, Mr. Pierson, the designer of the Vimy and the Viking, said that he thought the time had come when pilot and designer should work together to improve the design of aircraft. I do not guarantee the exactitude of the wording, but Mr. Pierson's meaning was clear—the aircraft designer of today wants the skilled pilot's knowledge (accumulated by experience in the air) and also the pilot's application of that knowledge in his considered criticisms of aircraft.

There are many pilots flying today who are most excellent pilots. Their sense of balance and their judgment in handling controls is well-nigh perfect. They are born pilots. They could balance a tray on the bridge of their nose, or a golf club on their chin, equally well. They are good, sound, safe pilots. But many of them simply cannot describe any of the *sensations* of flight, nor can they detail accurately how a machine behaves in the air. The engine was all right or it wasn't. The machine ditto. They have observed no detail, they cannot suggest any alterations to improve the flying qualities of the craft. They have no technical knowledge, and they have not used their opportunities to acquire such knowledge. As test pilots they are useless to the designer.

If designers want the services of pilots who can assist them, who can accurately report on the behaviour of an aeroplane in terms that mean something, who can offer suggestions of value, who can actually assist them in their endeavour to advance their designs, then surely these pilots should be paid for their abilities?

I imagine that most designers do think this, but they are not responsible for the financial side of their firms. The director or secretary who engages the pilot simply wants a man who can fly at the cheapest possible figure. Most aircraft firms are experiencing difficulty owing to the depreciation of currency and small orders. They endeavour to cut expenses to the minimum. And the pilot is one of the first to suffer. A firm without a retained pilot tries to cut the pilot's fees, and usually selects the lowest bidder for the job, irrespective of qualifications. And the designer suffers in silence.

A really good test-pilot must possess certain qualifications besides being a first-class pilot. He must have nerve, quick perception, ability to "size up" a new machine, the faculty of accurate observation of flight "sensations" and the flying qualities of aircraft, ability to express his observations clearly and in their true ratio, and sufficient technical experience to enable him to assist the designer in arriving at the correct deductions from the observations and their application to the machine undergoing tests.

Consider the whole question purely on a financial basis. It is the best way. Money talks louder today than it has ever done.

Take a pilot who has flown 500 hours (that may be taken as the *minimum* experience required by most firms), and convert it into money values. The lowest average cost of flying per hour is ten pounds, and I submit that the War-trained pilot's flying experience cost much more. But, taking the lowest figure, a pilot is not considered sufficiently experienced to be worth while, at a training cost of less than £5,000. I can imagine the director or secretary of the company indignantly exclaim, "Yes, but who paid for that? The Government, the tax-payer, ourselves!" Quite so, when you leave out the risks the War pilot ran, the services he rendered to the country, on a pay that was less than that often earned by munition workers at home, and eliminating the fact that he was the man who brought the aviation firms their handsome War profits. He earned his capital valuation.

Today, despite his costly training, he is often expected to offer his skilled services at less than the wages of a miner.

Possibly there are not many civilian pilots in this country with all the qualities I have outlined as desirable in the test pilot. But a man possessing these qualities can turn his hand to almost anything. He may love flying, but if other professions offer better prospects he will assuredly give up aviation. And aviation can ill afford to lose the few we have.

There has been much talk (at conferences and elsewhere) about the future developments of aircraft. Always I have looked for, and always I have failed to find, any mention of one of the most important factors controlling the expansion of aviation services. So long as aeroplanes are propelled by petrol (or steam) engines, skilled pilots will be required to ensure safety to the craft and passengers. *Before aviation services can expand pilots must be found.* The present tendency in civil aviation is to drive pilots into other occupations. When the time comes for the prophesied expansion, where are the pilots to come from? No individual will pay the sum required for training if pilots' salaries are small. If less flying experience is considered good enough, then the percentage of accidents will most likely increase and the expansion cease to expand.

I know that the R.A.F. have appointed many officers to Short Service Commissions, most of whom I venture to suggest have accepted these commissions to give them time to look about for a job outside the Service, and preferably a non-flying job, at a decent remuneration. Very few of them are likely to be keen on a civil flying job at average civil flying salaries. The men who were keenest on civil life (with its added individual responsibilities and anxieties) left the Service soon after the Armistice. Those who remained on have so much paid into their banking account every month, and are looked after in a way that a civilian is not looked after. Many of the Short Service officers hanker after a permanent commission. I do not decry the service pilot. I simply emphasise facts.

I do not think the future need for civil pilots can safely be entrusted to the R.A.F. We have been told that civil aviation must stand or fall by itself. In my opinion, in its present attitude of indifference as to what becomes of the men who can fly, it looks very much like falling.

There is a sufficient number of sound pilots available at the moment. In five years' time, ten years' time, there may be an astonishing scarcity of really good pilots. A pilot's life as such must necessarily be short. The average man cannot expect to go on flying steadily long after he is forty, at any rate.

The R.A.F. suits itself and takes on Short Service pilots now, but its future permanent officers are most likely to come straight from the public schools *via* the R.A.F. Cadet College. There is no guarantee that the Short Service commissions will continue in the future. Rather is it the reverse. And R.A.F. authorities have stated that they look to civil aviation to provide a reserve for national emergencies.

I put it to those interested in civil aviation today that it is up to them to look ahead. Machines may be forthcoming, cargo, passengers, and aerial routes may be obtained, but if civil aircraft firms are not careful, the time may come when machines, cargo and passengers are hung up awaiting the return of that white-haired veteran servant of the company, the last War pilot able and willing to carry on, from the trip he has started on with those who were lucky enough to head the queue.

I submit that there is much to be done. The good pilots we have today ought to be retained. When the need begins to be felt (let us hope it is soon for the sake of civil aviation!) air transport companies must bethink them of their future pilots. Why not take on approved apprentice pilots, have good instructors to put them through on school machines, fit the passenger carriers with dual control, and do not certificate a "pass schools" pilot fully qualified until he has flown a satisfactory number of hours as assistant pilot on the passenger carrier, as well as having flown it solo. I suggest that something on these lines will become necessary. Qualified instructors are available today. They may not be so easily obtainable five years hence. It is up to the air transport companies to consider the whole question. If satisfactory salaries are paid, premium apprentice pilots will be assured. As we stand today, if there is any genuine hope of speedy expansion in air services the far-sighted company that retains as many pilots as it can possibly afford will reap a sure reward.

The test pilot is even more valuable.

NORMAN MACMILLAN,
M.C., A.F.C., A.M.I.Ae.E.

Bristol, November, 1920

A Flying School for Ecuador

IT would appear that the exhibitions of flying arranged in connection with the centenary celebrations in Ecuador have not been without effect. At any rate, it is reported that President Tamayo, of Ecuador, has signed a decree authorising the establishment of a school of aviation at Riobamba.

THE PROBLEM OF THE HELICOPTER*

BY LOUIS DAMBLANC

It is a very great honour to me to have to speak this evening before this learned assembly, and I have to thank you very sincerely for the occasion which you have offered me of discussing before you a very important question, one which is of interest to the whole of the aeronautical world, namely, the problem of the helicopter.

My aim will be but modest, for I shall simply attempt to develop those essential arguments which have given me such entire confidence in the practicability of this type of heavier-than-air machine, and I shall be content if at the end of this paper I have been able, not to convince you, but at least to interest you in the cause which I have at heart.

The helicopter is not a competitor of the aeroplane. It is an entirely different type of aircraft, but the one is the complement of the other, and if their respective uses are not the same, they nevertheless will be of equal importance in that immense future which we all believe to be reserved for aircraft.

For military purposes the helicopter will be an incomparable observation machine, and, when its horizontal speed becomes equal to that of an aeroplane, a formidable bombing machine. For work at sea its advantages are evident. Aeroplanes cannot land on the decks of warships except in the face of great difficulties and with the aid of special and encumbering landing decks, which involve a waste of space which can scarcely be tolerated.

The helicopter alone is capable of getting over these difficulties in a satisfactory manner. By its use it will be possible to rise vertically from the deck of a ship and to land in the same way. Merely to mention these several applications is to justify the interest which has been taken in the attempts to develop this type of machine.

I will not waste time in discussing the history of the helicopter. All the world knows that for more than a century many inventors in England as in France have taken intense interest in this problem. The greater number of them have stopped short at the production of children's toys, using for motive power, either bent whale-bone, skeins of rubber or steel springs.

One has only to read the numerous patent specifications which have been taken out concerning helicopters to realise that most of the authors have had either the most elementary or the most fantastic ideas.

The majority of the patentees have considered only vertical ascent of the machine, and have concerned themselves neither with the maintenance in the air nor the gliding descent of the machine. Such conceptions will not stand examination.

In order to be practicable, any kind of flying machine must give complete guarantees of stability under all circumstances of flight.

It was in 1903 that the late Col. Renard, in a very striking communication to the Académie des Sciences, brought the first gleam of light to bear upon the conditions of vertical flight. This scientist with sure intuition, with enlightening and fertile reasoning, has established the fundamental laws which still rule in all practical enquiries into the behaviour of lifting airscrews. I propose to speak of his works, and I shall divide my study of them into three chapters :—

(1) Lifting force and lifting airscrews ;
(2) Construction of helicopters ; and
(3) The gliding descent of a helicopter with stopped engine.

(1) *Lifting Force and Lifting Screws*

Col. Charles Renard, in three communications to the Académie des Sciences, has dealt completely with the question of lifting airscrews. I will recall to you the title of his celebrated notes.

The first (November 23, 1903) was entitled "Upon the Possibility of Sustaining in the Air a Machine of the Helicopter Type, using Internal-Combustion Engines in their present state of Lightness."

The second (December 7, 1903) bore the title "Upon the Qualities of Lifting Airscrews," and finally the third, presented several months before his death at Chalais-Meudon (where during twenty-seven years he had unceasingly pursued his scientific researches) was entitled "A New Method of Construction for Airscrews."

With the aid of aerodynamic balances, Col. Renard had spent eighteen years in studying completely the functioning of lifting airscrews, working with no translational motion, and he had determined the characteristic equations of their operation. The fundamental formulæ arrived at by Col. Renard are the following :—

Thrust in Kg. $= F = \alpha n^2 D^4$

Power expended in H.P. $= T = \beta n^3 D^5$

Where n = revolutions per second, D = diameter of the screw in metres, and α and β are constants for any member of a family of similar airscrews.

The expression for the useful thrust per horse power absorbed is given by

$$\frac{F}{T} = \frac{\alpha}{\beta D} \times \frac{1}{n}.$$

It can be seen at once that for the same airscrew the thrust per unit of power is greater and greater as the speed of revolution becomes smaller.

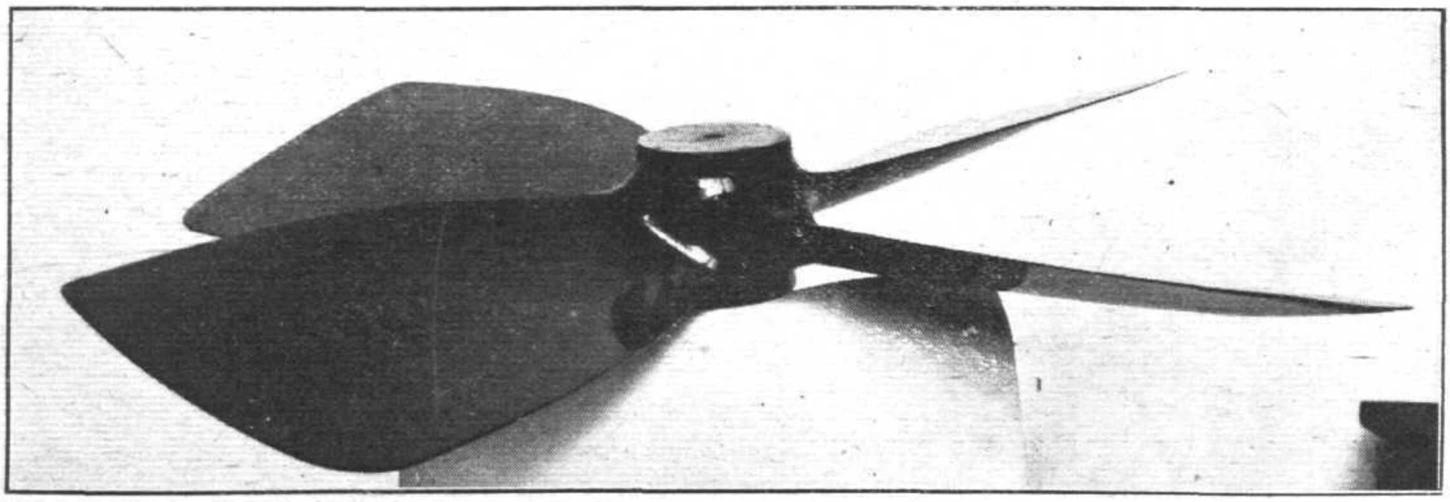
Sustantative Value (Qualité sustentatrice).—Col. Renard has given this name to a characteristic figure used in the study of an airscrew, which is determined in the following manner :—

For an airscrew of diameter D the area of the circle swept out by the blades will be :—$S = \frac{\pi D^2}{4}$.

If we call S′ the area of an imaginary plane which dropping vertically at a speed, V′ will produce the same thrust F as that given by the airscrew for a power expended = T, then the "qualité" or sustentative value defined by Renard is $q = \frac{S'}{S}$.

It can be seen at once that S increases with the "qualité" of the airscrew. In order to obtain given thrust F, the greater the equivalent plane is the less is the work expended in order to obtain this given thrust. This simple statement proves that augmentation of the "qualité" is equivalent to increasing the aerodynamic efficiency of the airscrew in question.

* Paper read before the Royal Aeronautical Society on November 18.



THE DAMBLANC HELICOPTER : Photograph of a scale model of the two direct-lift screws employed on the Damblanc "Alerion."

If K is the normal resistance coefficient of air one has in the case of the equivalent plane

$$F = KS'V'^2 \text{ and } T = FV' = KS'V'^3$$

from which $\frac{F^3}{T^2} = KS' = \frac{\alpha^3}{\beta^2}D^2$, which gives

$$S' = \frac{\alpha^3}{\beta^2} \cdot D^2 \cdot \frac{1}{K}.$$ The value of q is

$$q = \frac{S'}{S} = \frac{\alpha^3 \;.\; D^2 \;.\; 4}{\beta^2 \;.\; K \;.\; \pi D} = \frac{\alpha^3}{\beta^2} \cdot \frac{4}{K\pi}.$$

It will be seen that the "qualité" independently of diameter is a constant for all members of a family of geometrically similar airscrews.

Col. Renard has indicated, without actually proving the fact, that the quality q has a maximum value of :—$q = 6\rho^2$, ρ being the efficiency, which, since the efficiency cannot exceed unity, gives as a limit $q = 6$

The experiments undertaken by Monsieur Riabouchinsky at the Aero-Dynamic Laboratory at Koutchino on this matter are most valuable and most conclusive. The results given in the following table concern the two-bladed airscrew of om 30 diameter turning to 30 revolutions per second and running in a current of air perpendicular to its axis. This airscrew had 40° blade angle, at the centre.

TABLE I

Air Speed perpendicular to the axis of rotation.	Thrust Kg.	Power Absorbed H.P.	"Qualité" q
0	0.036	0.32	0.08
2.5	0.050	0.33	0.19
4.2	0.065	0.30	0.50
5	0.074	0.29	0.80
6.2	0.082	0.28	1.16

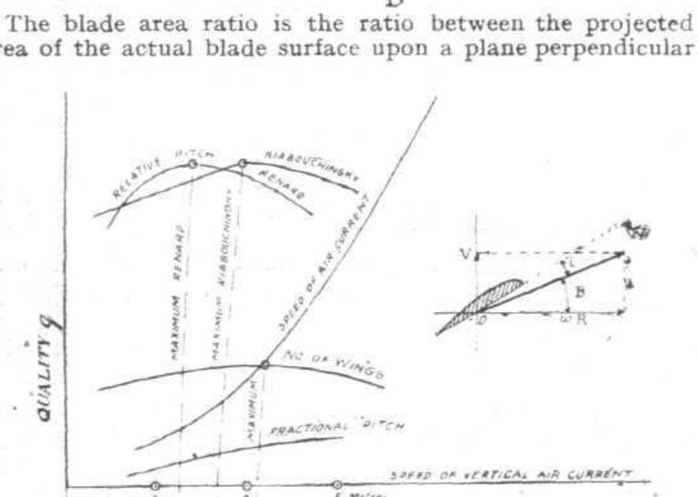
Some Definitions.—If V = the speed of ascent in metres per second, N the number of turns per second of the airscrew, W = the relative speed of the air for an element of the blade—ds—situated at distance R from the centre of rotation.

The pitch or advance per revolution is :—

$$H = 2\pi R \tan(\beta + i).$$

The pitch diameter ratio is $h = \frac{H}{D}$.

The blade area ratio is the ratio between the projected area of the actual blade surface upon a plane perpendicular



to the axis of rotation and the surface of the circle swept out by the screw of diameter. The curves below give for lifting airscrews the general form of the curves of variation of the "qualité" expressed as a function of the four parameters. These are the speed of the perpendicular current of air, the blade area ratio, the pitch diameter ratio and the number of blades. These curves are arrived at from the work of Col. Renard and M. Riabouchinsky (Pamphlet No. 11, Bulletin de Koutchino).

(2) *Construction of Helicopters*

If the manufacturers of toy helicopters are innumerable, the various investigators who have built full-size machines to verify their ideas are, on the contrary, very few. Before the War, in France, M. Louis Breguet, the famous builder of aeroplanes, had constructed a helicopter (the Breguet-Richet helicopter) which gave quite a number of interesting results.

M. Breguet was, however, only concerned with the actual lifting force of airscrews, *i.e.*, he limited his efforts solely to solving one side only of the problem, and it has been the same with all the other investigators, in particular Mr. Cooper-Hewitt, who has made static tests on lifting airscrews driven by an electric motor in America. But since 1918 there have been brought forward several projects for the building of helicopters, capable not only of sustaining themselves but also of steering and of landing properly in gliding descent in case

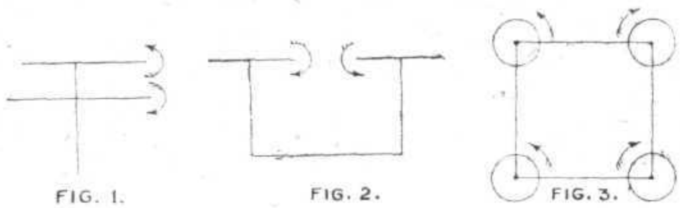


FIG. 1. FIG. 2. FIG. 3.

of a break-down of the engines. The whole problem of the helicopter is summarised in these three conditions, of lifting, of horizontal translation and of gliding descent.

The Two Types of Helicopter

It is necessary in any scheme for a helicopter to split up the lifting force between two airscrews or pairs of airscrews turning in opposite directions in order to avoid the rotation of the machine itself around the axis of the airscrew. One can conceive of helicopters under the three aspects shown in Figs. 1, 2 and 3, but in reality there only exist two separate types (1) the machine with the single axis and (2) that with separate axis.

Advantages of the single axis : Great mechanical simplicity and consequent lightness.

Advantages of the separate axis : Better aero-dynamic efficiency of the lifting airscrews.

Construction of Lifting Airscrews.—It has been seen that for lifting airscrews a very large blade and ratio was compatible with high efficiency. The optimum diameter for a lifting airscrew is 7 metres, and as far as the number of blades is concerned I have always considered that 4 was the best number. The blade of a lifting airscrew is comparable in dimensions to the wing of an aeroplane, but the loads which it has to carry are not similar. Its actual construction should be carried out with spars and ribs and particularly strong bracings, the whole covered with fabric and doped exactly like the wing of a monoplane. A blade should be designed to resist the following forces :—

(1) The static loads which depend only on the weight of the machine. For these loads a suitable factor of safety would be seven.

(2) Centrifugal loads. These are considerable in a screw of large diameter. A blade weighing 30 kg. 3 metres 50 radius with its centre of gravity 2 metres 50 from the axis is subject at a speed of 200 revolutions a minute to a centrifugal force.

$$Fc = mw^2r = \frac{30}{9 \cdot 81}\left[\frac{2\pi \times 200}{60}\right]^2 2 \cdot 5 = 3{,}300 \text{ Kg}.$$

It is obviously necessary that the spars should be placed radially in the blade.

The weight of a lifting airscrew will, all other things being equal, obviously be greater than the wing of an aeroplane of the same surface.

During the recent construction of an experimental helicopter I have found that it was very difficult to build a blade of such a lifting screw giving a high factor of safety for a weight of less than 8 kg. per square metre. In this weight it included all the bracings, fabric, dope and varnish, in fact the whole weight of the rotating wing in working order. At the same time I believe that by reducing the diameter of the screws from seven to six metres and taking speeds of rotation of the order of 150 r.p.m., the weight per square metre can be reduced to 7 kg. Further, by using a biplane construction which allows a still further slight reduction of diameter and the replacement of bracing wires by well-streamlined struts one will easily be able to reach 6 kg. per square metre. It is this figure which will be taken in the estimates which follow.

The peripheral speed of a lifting blade should not exceed 50 to 60 metres per second on account of the difficulties of construction. The peripheral speed of ordinary propulsive airscrews built of wood can easily reach 300 metres per second. All the before-mentioned considerations have to be taken into account before one can attempt the serious construction of a lifting airscrew. I give below by way of example the results of an official test upon a complete model one-seventh of full size of a lifting airscrew which I have built. The full-size wing has given under loading tests a factor of safety of 8.

TABLE 2

Date of Test—September 5, 1918

Thrust kg.	3	8	13	18
R.P.M. of screws ...	480	778	1,008	1,169
Power absorbed at airscrew shaft H.P. ..	0.25	1.03	2.18	3.47

Barometer at time of test (corrected to 0 degs. C.) 776.5 mm. Temperature, 22 degs. C.

In order that two airscrews may be strictly geometrically similar they ought not to vary in their form under load. It is perfectly certain that the above model and the full-size rotating wing will not deform to the same extent when rotating since they differ in construction, but even if there is a difference it will be compensated for by the improvement due to the known superiority of full-size results over those deduced from model tests. In spite of the great width of the blades of this airscrew the figures obtained from it very closely conform to the theoretical formulæ to Col. Renard. In order to interpret the results we must apply the two fundamental relations :—

$$\text{Thrust in Kg. } F = \alpha n^2 D^4.$$
$$\text{H.P. } \quad T = \beta n^3 D^5.$$

The results of the last column of the table of tests of September 5th, 1918, given for the model tested:— $n_1 = 1{,}169$ r.p.m. $= T' = 3 \cdot 47$ H.P. and $F^1 = 18$ Kg.

The diameter and the maximum speed of rotation of the rotating wing of the full-size machine are $D = 7$ metres, $n = 160$ r.p.m. If we designate by T the power necessary at the shaft of the full-size screw and by F the corresponding lifting thrust we shall deduce from the results of the model test the following value for lift and the power :—

$$T = T_1 \left(\frac{N}{n_1}\right)^3 \left(\frac{D}{a}\right)^5 = 3 \cdot 47 \left(\frac{160}{1169}\right)^3 \left(\frac{7}{1 \cdot 05}\right)^5 = 115 \text{ H.P.}$$

$$F = F_1 \left(\frac{N}{n_1}\right)^2 \left(\frac{D}{a}\right)^4 = 18 \left(\frac{160}{1169}\right)^2 \left(\frac{7}{1 \cdot 05}\right)^4 = 700 \text{ Kg.}$$

The actual helicopter which is in view uses two turning wings geometrically similar to that of the model tested, and each of these wings will then be capable of a thrust of 700 k. for a power of 115 h.p. The supreme importance of this test lies in the fact that the actual helicopter as built only weighs 1,200 kg. and consequently each of the wings will only have to support 600 kg.

In addition, the useful power available per wing is 130 h.p., and finally the fixed incidence given to the blades of the model was 10 degs. The excess of lifting force therefore is approximately 200 kg. for two wings together.

Stability of the Helicopter.—With reference to the centre of gravity of the helicopter we have to take account of three conditions of stability :—

(1) Longitudinal stability, which must be obtained around a horizontal axis through the centre of gravity and parallel to the plane of symmetry.

(2) Lateral stability; stability around the axis parallel to the span and passing through the centre of gravity.

(3) Rotational stability round a vertical axis through the centre of gravity.

In order to maintain its equilibrium in all positions a helicopter must possess rudder, elevator and special arrangements capable of producing effects similar to those due to the *ailerons* of an aeroplane. This question of stability is the most important that one met with in the helicopter, and various solutions, several of which have already given valuable results, but into the details of which it is not now permissible to enter, are now being tested.

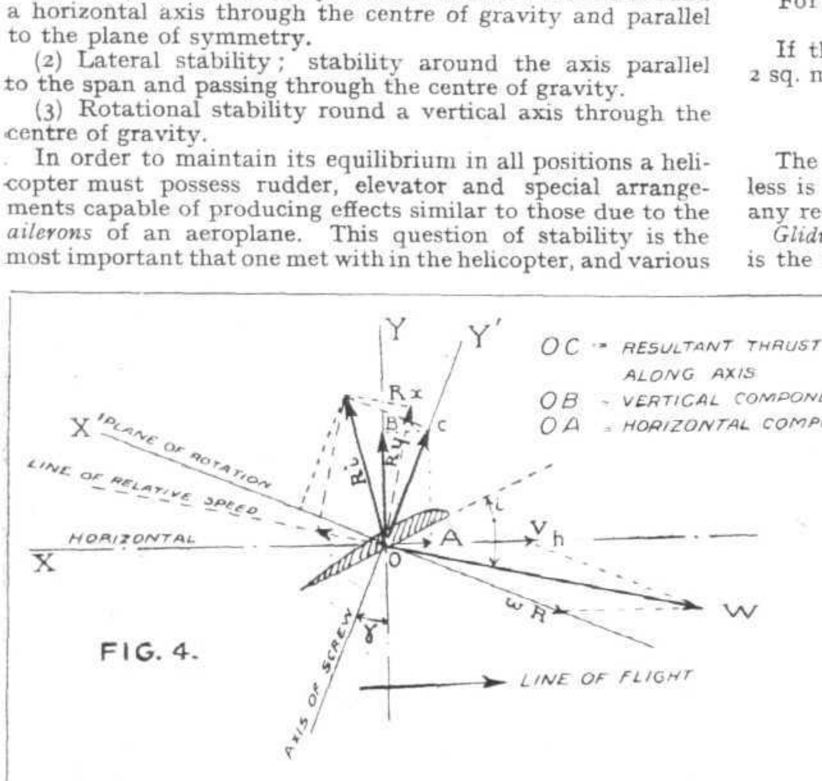


FIG. 4.

Equations of sustentation and practical coefficients

Calling

T = H.P. supplied.

p = weight of airscrews.

η = efficiency of transmission gear.

q = "qualité" of airscrews.

S_1 = Surface of normal plane equivalent to the resistance to vertical ascent.

$K = 0.08$ = normal coefficient of resistance (flat plane).

F = Thrust (left) in Kg.

P = Total weight of helicopter.

n = Revolutions per second of airscrews.

Taking the case of a machine with two screws each 7 metres diameter, with four blades at the ground, the equation of equilibrium is

$$P = 2F = 2\alpha n^2 D^4.$$

If the force F becomes superior to P, the helicopter leaves the ground.

The acceleration on leaving the ground is :—

$$\frac{P}{g} \gamma = 2F - P - KSV^2.$$

The term KSV^2 is negligible at the start.

It has already been shown that the interpretation of the results of Table No. 2 gave for $D = 7$ metres and $n = 160$ r.p.m. $F = 700$ Kg. or $2F = 1{,}400$ Kg.

Weight of the Helicopter.—It may be taken that the weight of a helicopter, with 250 h.p. engines, will weigh in flying order 1,000 Kg. = P.

At the rate of 6 Kg. per square metre, the weight of the screws (of 40 square metres) will be $p = 6 \times 40 = 240$ Kg.

Experience has shown that the total weight P is about

$$P = 4p$$

Speed of Climb at Start.—$\frac{P}{g} \gamma = 1{,}400 - 1{,}000 = 400$ Kg.

from which $\gamma = \frac{400 \times 9 \cdot 81}{1{,}000} = 3 \cdot 80$ metres per sec.

The general equation for the vertical flight of a helicopter is of the form :—

$$\frac{P}{g} \cdot \frac{dV}{dt} + P + KSV^2\mu - \frac{\eta T_o}{nD} \mu = 0.$$

Where η = efficiency of the transmission gear ($= 0 \cdot 95$).

μ = the density of air at the altitude Z

T_o = Engine power at sea level.

Speed of Horizontal Translation

It will be seen that if 2F is the total resultant thrust along the inclined axis OY' of the airscrews that the total horizontal component (OA for the element *ds*) will be for the whole machine :—

$$\Sigma OA = 2F \sin \gamma.$$

For $2F = 1{,}400$ Kg. $\gamma = 10°$.

$$\Sigma OA = 1{,}400 \times 0 \cdot 174 = 250 \text{ Kg.}$$

If the resistance to horizontal flight is the equivalent of 2 sq. metres of normal surface the speed of translation will be

$$V = \sqrt{\frac{250}{0 \cdot 08 \times 2}} \times 3 \cdot 6 = 140 \text{ km.p.h.}$$

The lower the resistance to translation at movement the less is the inclination of the airscrew axis necessary to give any required horizontal speed.

Gliding Descent of a Helicopter with Stopped Motor.—This is the most vital point in the problem of the helicopter, for the adversaries of this type of heavier-than-air machines make it their essential argument that a safe descent under these conditions seems to them to be impossible. I wish to show in what follows that the vertical gliding descent of the helicopter with unclutched screws is actually possible, and to conclude that there should be no delay in solving this problem.

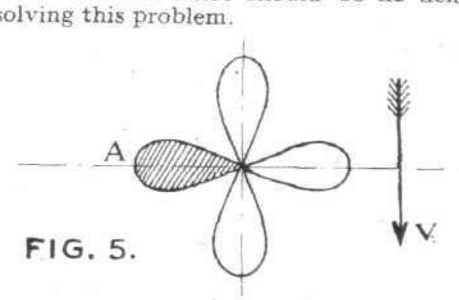


FIG. 5.

A descent with stopped motor can occur in two manners. First, airscrews declutched, turning round their axis as windmills, with a suitable incidence on the blades so that their direction of rotation may not be replaced.

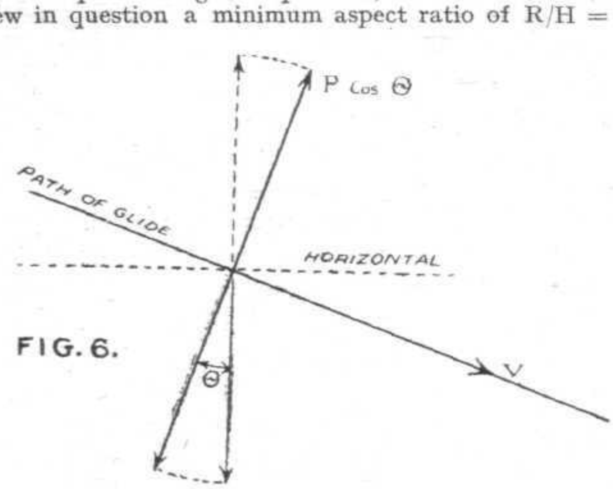
Second with airscrews stopped in first position as soon as the engine stops.

Fixed Screws.—I shall have little to say upon this second solution of the problem, in which I have very little confidence. It is equivalent to turning the helicopter into a very bad glider which will descend in a path very much as an aeroplane does, and this thanks to the use of appropriate gearing.

The total surface of the glider in this case will always be less

than the sum of the real surfaces of all the blades of the airscrews. This "cut up" surface will have a very poor efficiency because of the very unfavourable conditions under which the blades have to work. The real surface available for gliding with fixed airscrews will also always be inferior to the surface swept out by the same airscrew in rotation. Then admitting that the blade area coefficient is equal to one, that is to say that the total surface of the blades is equal to the surface of the total swept circle, the component Ry of the resistance will be very much less than that corresponding to an ordinary wing of the same surface. Only the blade A (Fig. 5) *i.e.* one quarter of the total surface, if it is a four-bladed screw, will be working under normal conditions. For the other blades of the airscrew the leading edge will be either the trailing edge, or the tip of the blades.

The mean lift coefficient of such a set of surfaces will be very small and probably of the order of one quarter of that of a good biplane wing. In practice, if we take for the airscrew in question a minimum aspect ratio of $R/H = 1 \cdot 75$



for R = 3 metres 50, we shall have the real surface for the airscrew fixed in position for the gliding descent of

$$S = \left(3 \cdot 5 \times \frac{2 + 1}{2}\right) 4 = 21 \text{ sq. metres.}$$

For the two screws of the helicopter we have taken as the total surface S = 40 metres square. For straight gliding descent taking a mean figure of 5° incidence and an air speed of 110 km. an hour (30 metres a second approximately). The equation for the lift is then $P \cos \theta = Ky\, SV^2$,

P = the total weight of the machine. S = lifting surface = 40 square metres. V = speed of translation along the line of gliding flight.

The lift of a good wing section for $\theta = 5°$, $Ky = 0 \cdot 03$.

The lifting surfaces now in question work under such unfavourable conditions that it is only permissible to take a very low value of K.y., for instance that corresponding to the Bristol wing (Air Board, May, 1916), which for the angle of attack of 5° is $Ky = \cdot 007$.

Then
$$P = \frac{Ky\, SV^2}{\cos \theta} = \frac{\cdot 007 \times 40 \times 30^2}{0 \cdot 996} = 255 \text{ Kg.}$$

We have then a glider which is not capable of sustaining more than 6.5 kilos. per square metre. It has been seen above that the airscrews themselves weigh at least 240 kilos. and that the total weight of the helicopter is about four times this weight—that is to say, about 960 kilos. It is, therefore, extremely likely that such a machine with stopped motors will dive to the ground nearly vertically and at a high speed. If we take it that a normal glider can carry 30 kilos. per square metre, it will be seen that the efficiency of the fixed airscrew system is about five times less than that of the normal glider, and that it is obviously too low.

Finally the mechanical action of stopping and fixing the airscrew instantaneously in the desired position will be very great, and, more than that, very serious disturbances of the normal operation of the machine are to be expected at the same time.

Case of the De-clutched Airscrews.—This is the only rational solution of the problem of controlled descent of the helicopter with stopped engines. It is proposed to examine in detail this important subject. In the first place, centrifugal de-clutching—that is to say, use of a clutch which operates in accordance with the speed of the engine—is obviously suitable, because the operation is automatic and immediately frees the airscrews from the engine as soon as this stops from any cause whatever. Two cases have to be considered.

Stoppage of the Engine during Vertical Ascent.—Immediately on the stoppage of the motor the balance between the lift of the airscrews and the weight of the machine is destroyed. If the readjustment does not occur immediately a catastrophe is inevitable, because the screw de-clutched and still turning in the same direction tends to stop and then to reverse. There is therefore produced momentarily a break of continuity in the equilibrium of the system, for the lift will drop to zero at the period of reversal of the airscrews. Fig. 7 represents upon one element of the blade situated at the distance R from the axis of rotation the resultants of the reaction of the air during normal ascent. If we admit the hypothesis that the machine will not be out of equilibrium in its path of descent during the period of zero lift corresponding to the reversal of the screws, there must be a new state of equilibrium characterised by Fig. 8. The only acceptable solution, however, is, it can be seen, that of Fig. 9, for this allows maintenance of the same direction of rotation of the airscrews as in ordinary flight, with stopped engine. The lifting force is transformed immediately into a breaking force, and no accidents are to be feared under these conditions.

The normal descent of the helicopter with stopped engine should be made with de-clutched airscrews and with blades readjusted to give the same direction of rotation.

Engine Stopping During Horizontal Flight.—It has been seen in the consideration of lifting force that the angle γ is very slight, and that a small inclination of the axes of the airscrews provides a horizontal component sufficient for the forward movement of the machine. Let the vertical speed be considered zero at the moment of the stoppage of the engines. The element—*ds*—of the blade at this instant will be at the position (1) of Fig. 10. The relative speed of the blade—*u*—will diminish rapidly with the angle 1, as will the component O.B. (the left component). By use of the elevator one can immediately bring the axis of the airscrews back to the vertical, and C.Y.[1] and C.X.[1] will coincide with C.Y. and C.X., and the machine will no longer move forward. At this moment the element *ds* occupies the position 2. The vertical speed of descent for the first second is large relatively to ω, which diminishes very rapidly. The angle of incidence 1 may at this moment have very large value, something in the neighbourhood of normal attack, and we have therefore arrived at the position 2. In the same case is that already treated—stoppage of the motor during vertical descent, and the diagram of Fig. 9 gives the solution desired. It is to be

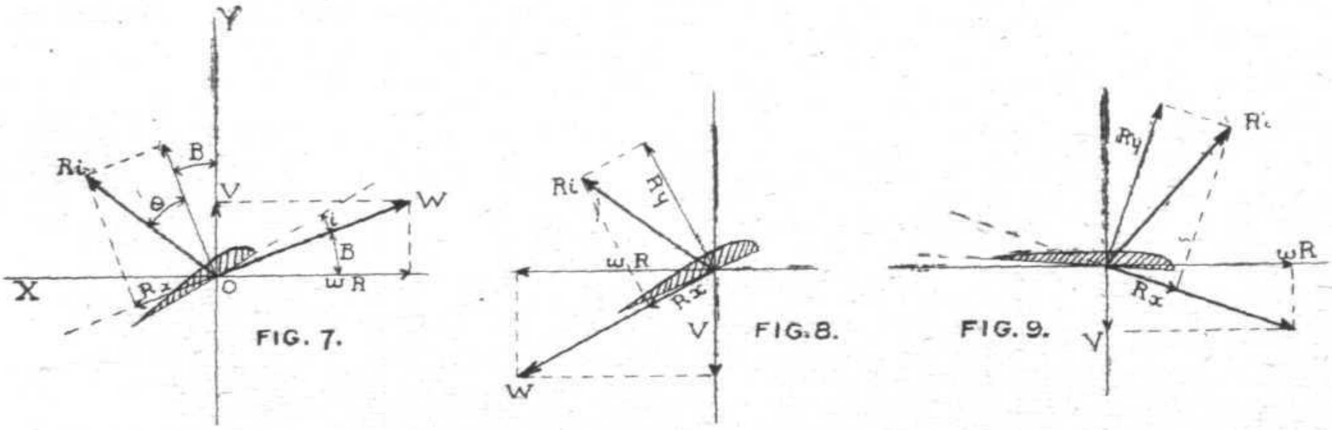


Fig. 7. Vertical ascent with engine running. Fig. 8. Vertical descent at same angle of incidence and with motor stopped. (Screw declutched, rotation in opposite direction.) Fig. 9. Correct vertical descent, screw rotating in same direction.

remarked that position 3, which is reached as the last manœuvre for vertical descent approaches position 1 for horizontal flight, but with position 1 the axis of the airscrew is inclined, and in position 3 this axis is vertical. Even in this very general case, it can be seen that the braked descent

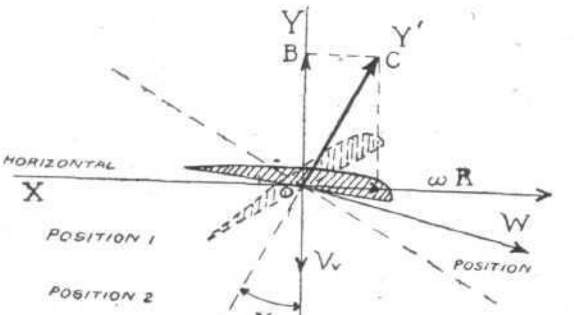


FIG. 10

presents no serious difficulty and that the problem is quite simple to solve.

It is equally possible to conceive in the case of the helicopter with de-clutched screws a spiral gliding descent. In this case the machine descends in spirals at a uniform speed, and turning round a vertical axis and the centre of gravity will describe a helix, and in order that equilibrium may be *maintained it is sufficient that the vertical velocity of descent should remain in the plane of symmetry of the whole.*

In the equations of equilibrium of the helicopter it will be necessary to take into account the centrifugal forces due to the rotation of the whole machine, which are more or less important as the radius of the cylinder of revolution becomes greater.

The vertical gliding of the machine at a uniform speed produces no supplementary inertia forces. All other things being equal, it is perfectly certain that in spiral descent the vertical speed of gliding will be sensibly less than in the case of the vertical gliding descent.

From recent experiments it appears, and calculations confirm the results of these experiments, that a good lifting airscrew used as a brake in this way at the optimum angle of attack will give for two blades a breaking force

$$F = 0{\cdot}2\, V^2D^2$$

For a four-bladed screw we shall have 2F, the breaking effect being proportional to the surface. It has already been said that for the best lifting airscrew $D = 7$ metres. The table below shows the very great increase in the braking effect F with increase of the vertical speed of descent. I have added to the same table the weights for an airscrew 7 metres diameter with four blades of 16 square metres surface, weighing 6 kilos. per square metre, or 96 kilos., in rough figures 100 kilos. The last column gives the excess of braking force over the weight of the screw itself, which is available for descent.

Velocity of ascent, metres per second.	Braking Force $F = 2 \times 0.2\ V^2O^2$. kilos.	Weight of Screw. kilos.	Excess F per screw. kilos.	Excess F for the two screws. kilos.
3	178	100	78	156
4	315	100	215	430
4·5	400	100	300	600
5	500	100	400	800
6	700	100	600	1,200

It has been shown that the total weight of the helicopter is roughly four times the weight of the screws, or in the case which is now being considered 800 kilos. For the speed 4 metres 50 per second we have therefore descent in equilibrium.

What is Safe Limit for Vertical Descent?—It has been claimed by certain persons that 3 metres per second was the limiting speed allowable for descent, and that the human organism could not tolerate without serious inconvenience more than 4 metres. I would simply remark here that it is admitted in fact that a normal aeroplane is considered to allow of safe landing when the horizontal speed near the ground is 110 kiloms. per hour and its vertical speed is 4 metres per second. In gliding flight a horizontal speed of 180 kiloms. is normal and the vertical velocity of descent is about one-tenth of this value which becomes in this case 5 metres per second. All good pilots are unanimous in stating that landing under these conditions is perfectly supportable.

The Inter-Allied Commission in their reports upon parachutes for aircraft take as a basis for their investigation the following condition :—" Speed of descent less than 5 metres a second," which is to say, a speed of descent up to 5 metres a second can be tolerated, and finally, which is very important, the Service Technique l'Aéronautique Française, in their specifications for new aircraft, impose upon the under-carriages of night-flying aeroplanes the following conditions :—" The elastic connections shall be designed for forces which shall not exceed those due to the machine falling vertically from a height of one metre." That is to say, that for a night-flying aeroplane the vertical speed of contact with the ground may attain, without danger, 4.9 (?) metres a second. It is therefore perfectly possible, using already known methods of shock absorbing, to consider that a safe vertical speed of descent for a helicopter is between 4 metres 50 and 5 metres a second.

For any airscrew we shall see that the braking effect is directly proportional to the square of the speed of descent. If for the screw of diameter 7 metres a speed of descent is $V = 2.5$, braking force $F = 122$ kilos. In this case it would become for $V = 5$ metres a second, $F = 488$ kilos. When the speed of vertical descent becomes twice as great the " braking " force becomes four times greater.

Conclusion.

In the golden book of the Science of Aeronautics, where there are already inscribed those glorious conquests which we know as " balloons," " airships " and " aeroplanes," the last page is reserved for the helicopter.

In a few months the helicopter will enter upon a phase of decisive achievement.

A fact which is remarkable is that with the helicopter no new principle is involved. Everything is known, and it is merely a question of adaptation. The progress of aerodynamics during the War will find here a direct application. Powerful and light engines of a high power to weight ratio, the improvement in the qualities of wings, the use in construction of light alloys will all play their part.

There is one single shadow over the picture; it is that of the difficulties of actual mechanical construction. The helicopter will be an instrument of precision whose parts will be united one to the other by members carefully constructed and minutely calculated. This heavier-than-air machine will be more than any other dependent upon craftsmanship.

But we have already solved an even more delicate problem in the construction of the aero engine, that veritable masterpiece of skilled and intelligent workmanship.

What will be the first use for the helicopter, the most important, the most desirable ? My own idea is that the first helicopter will be called more properly hydro-helicopter. For marine navigation work the value of the helicopter is of the very first order. The helicopter will be the eye of the ship. To state only one example of its use, I can see in the near future a flotilla of helicopters rise from the deck of a liner in distress, and take into security, several hundred metres above the angry waves, all the passengers, women and children, while they wait for a rescuing ship.

For naval purposes applications for the helicopter are of capital importance, for seeking out and for bombing submarines, for fire control, for inter-communication purposes, and for the carrying of supplies between squadrons the helicopter will necessarily be an invaluable auxiliary.

The probable characteristics of the first type of helicopter to be constructed will be something as follows :—

Total weight	800 kilos.
Useful weight, pilot and armament	150 kilos.
Engine power..	120 h.p.
Climbing speed	3 metres a second.
Horizontal speed	100 kiloms. an hour.

The construction of such a machine ought not to be far off, for—and this is I consider very important, even if all the problems which are encountered in the construction of the helicopter are not yet completely solved—the hydro-helicopter is nevertheless already possible and usable.

The Times, in an editorial notice on November 3, 1920, dealing with the question of landing an aeroplane on the deck of a ship, terminates its article with these words :—

" One can, therefore, have no doubt as to the importance of the helicopter."

I hope you will allow me, in finishing, to state that it is my convinced opinion that the year 1921 will see the realisation of the first practical flight of a helicopter flying machine.

Air Work in Mesopotamia

IN the *communiqué* issued by the War Office on November 19, it was stated :—

" Middle Euphrates.—An insurgent camp on the right bank of the Euphrates, 15 miles north-north-west of Musaiyib was attacked by our aeroplanes on the same date."

THE ROYAL AIR FORCE

London Gazette, November 16

Permanent Commissions

Wing-Com. L. L. Greig, M.V.O., M.B., is placed on the retired list at his own request; Nov. 18.

Stores Branch

The following are granted permanent commns. in the ranks stated, with effect from the dates indicated, retaining their seniority in the substantive rank last held prior to the grant of this commn. :—

Wing Com.—F. H. Kirby, V.C., O.B.E., D.C.M.

Sqdn. Leaders.—W. R. Bruce, O.B.E., T. O. Lyons, O.B.E., J. E. Parkin, M.B.E., J. H. Wilford.

Flight-Lieuts.—C. L. Archbold, W. E. Aylwin, O.B.E., F. A. Baldwin, N. R. Fuller, C. Mason, W. H. G. Maton, M.B.E., D. McBirney, J. Rylands, T. G. Skeats, R. W. Thomas, O.B.E., W. J. Waddington, O.B.E., B. W. M. Williams; June 17. W. C. Clark, W. Millett; July 20.

Flying Officers.—F. Anderson, T. Bell, M.M., E. S. Bullen, L. E. Carter, K. D. G. Collier, A. H. Comfort, J. P. Crichton, S. D. Dennis, E. C. Farman, T. Fawdry, M.B.E., W. A. Kingston, E. W. Lawrence, G. J. Maygothling, C. Y. Mitchell, D. Mitchell, A. J. Moore, J. R. Nicholls, T. J. Organ, F. J. B. Polwell, M.B.E.,; F. W. Powell, N. Robertson, H. Sleigh, K. A. Smith, G. T. Stroud, M.B.E., F. W. Todd, G. C. Wilson; June 17. J. Baxter, T. F. Beere, C. E. Cullen, H. J. Dann, C. T. Davis, G. Felstead, D.C.M., J. R. Gardiner, W. H. Harrison, H. Jones, A. Jukes, W. St. J. Littlewood, R. D. G. Macrostie, G. Oliver, H. Parker, F. Pratt, A. M. Saywood, R. J. Sladden, M.B.E., D.C.M., O. T. Stone, W. Thorne, A. W. Turner, F.R. Wilkins, E. R. Wood; July 20. R. Craig; Oct. 9.

R.A.F. Medical Service

302629 Sgt.-Maj., Class I, P. H. Musgrave is granted a permanent commn. as Qrmr. (Medical), with hon. rank of Flying Officer; Nov. 3.

Short Service Commissions

The following are granted short service commns. in ranks stated, with effect from dates indicated, retaining their seniority in substantive rank last held prior to grant of this commn., except where otherwise stated :—

Flight-Lieut. (from Sqdn. Leader).—R. E. Nicoll; Oct. 29.

Flying Officers.—H. W. Gardner; Oct. 22. W. B. J. Humphrey; Oct. 7 (and with seniority of that date). A. H. Klynes; Oct. 18. M. J. Langley; D.F.C.; Sept. 29. E. W. Nicholson; Oct. 25. A. J. Warwick; Nov. 4.

Pilot Officers, on Probation:—With seniority of Oct. 29:—F. V. Gauntlett, E. F. Kohler, C. D. Robertson, M.M., E. A. Rush; Oct. 29.

Note.—Flight-Lieut. Nicoll will be placed at the head of the list of Flight-Lieuts., and will retain seniority relative to officers who have been similarly gazetted to short service commns. in a rank lower than their previous substantive rank in accordance with his previous position on the gradation list.

The names of the following officers are as now described, and not as stated in the *Gazettes* of the dates indicated:—W. A. N. Appleford, J. C. B. Cumming, W. L. G. Spinney; Oct. 1. H. S. Sandiford; Oct. 26.

Flying Officer J. S. Griffith, D.F.C., resigns his short service commn.; Nov. 3.

The notification in the *Gazette* of Nov. 12 appointing Flight-Lieut. G. Stevens, O.B.E., to a short service commn., is cancelled.

R.A.F. Medical Service

The notification in the *Gazette* of July 13 appointing the following Flight Lieuts. to short service commns. is cancelled:—F. J. P. Saunders, W. F. Sheil, M.B.

Re-Seconding

The name of Flying Officer H. B. Hammond (Lieut. R.A.) is as now described, and not as stated in the *Gazette* of April 27.

Flying Branch

The following Sec. Lieuts. to be Lieuts.—W. R. Pearson; May 30, 1919 (since demobilised). J. Golman; July 24, 1919.

Sqdn. Leader D. R. MacLaren, D.S.O., M.C., D.F.C., is placed on the half-pay list, Scale (B); Sept. 1. Flight-Lieut. C. H. C. Smith, D.S.C., is placed on the half-pay list (Scale B); Nov. 10. Flight-Lieut. D. Cloete, M.C, A.F.C., is placed on the half-pay list, Scale (B); Nov. 15. Flying Officer E. M. Bates (Lieut. R.A.S.C.) relinquishes his temp. R.A.F. commn. on return to Army duty; Nov. 15, 1919. Lieut. J. H. G. Womersley relinquishes his temp. R.A.F. commn. on appt. to the T.F., and is permitted to retain his rank. Capt. R. V. James, D.F.C., relinquishes his temp. R.A.F. commn. on appt. to the T.F. Reserve, and is permitted to retain his rank. Lieut. (Hon. Capt.) L. Laing relinquishes his temp. R.A.F. commn. on appt. to the T.F., and is permitted to retain the rank of Capt.

The following are transferred to Unemployed List.—Sec. Lieut. J. McCormack; Feb. 10, 1919. Lieut. J. Anderson; April 16, 1919. Sec. Lieut. G. Stott; May 16, 1919. Lieut. J. H. Preston; June 1, 1919 (substituted for *Gazette* Feb. 24). Sec. Lieut. H. Hall; Sept. 18, 1919.

Administrative Branch

Lieut. (actg. Capt.) E. G. Etheridge relinquishes his temp. R.A.F. on appt. to the T.F. Reserve, and is permitted to retain rank of Capt.

The following are transferred to Unemployed List.—Sec. Lieut. (Hon. Lieut.) T. H. Hesketh; Feb. 27, 1919. Sec. Lieut. W. Graham; Oct. 28.

The notification in *Gazettes* of Aug. 19, 1919, and July 27, concerning Sec. Lieut. A. C. Cunnison are cancelled.

Technical Branch

Pilot Officer A. C. Cunnison to be Flying Officer, Grade (B); Jan. 10 (since demobilised). Sec. Lieut. A. C. Cunnison to be Sec. Lieut., Grade (B), from unempld. list; May 5, 1919. Lieut. (Hon. Maj.) R. A. Constantine relinquishes his temp. R.A.F. commn. on appt. to the T.F., and is permitted to retain rank of Maj.

The following are transferred to Unemployed List.—Sec. Lieut. W. M. Clayton; March 11, 1919. Sec. Lieut. (Hon. Lieut.) C. Wilson; Oct. 10, 1919. Lieut. T. J. Q. O'Hara; Sept. 16. (Substituted for *Gazette* Sept. 17.)

Memoranda

Ten cadets are granted hon. commns. as Sec. Lieuts. with effect from the date of their demobilisation.

London Gazette, November 19

Flying Branch

Observer Officer J. E. Kendrick, D.F.C., is restored to the active list; November 15. Lieut. N. Bouchier relinquishes his temp. R.A.F. commn. on appt. to T.F. Res., and is permitted to retain his rank. Sec. Lieut. (Hon. Lieut.) T. E. Bruce-Adams relinquishes his temp. R.A.F. commn. on appt. to T.F. Res., and is permitted to retain rank of Lieut. Lieut. V. H. Collins relinquishes his temp. R.A.F. commn., and is permitted to retain his rank

Transferred to Unemployed List.—Lieut. W. R. Pearson; September 15, 1919, substituted for *Gazette* November 7, 1919. Lieut. F. Cave-Brown-Cave substituted for *Gazette* October 29. Lieut. R. W. Godfrey; October 30.

Administrative Branch

Sec. Lieut. J. E. Carter to be actg. Capt. whilst empld. as Capt. from May 1, 1919, to Aug. 31 (substituted for *Gazette* of Sept. 12, 1919). Sec. Lieut. D. J. Evans is graded for purposes of pay and allces. as Lieut. whilst employed as Lieut. from May 1, 1919, to Oct. 14, 1919 (substituted for *Gazette*, Oct. 5). Capt. A. Ridley, M.B.E., relinquishes his temp. R.A.F. commn. on appt. to T.F., and is permitted to retain his rank. Lieut. (Hon. Capt.) A. Firth relinquishes his temp. R.A.F. commn., on appt. to T.F. Res., and is permitted to retain rank of Capt.

Medical Branch

Capt. R. G. J. McCullagh is transfd. to unempld. list; Nov. 1.

Memoranda

Four cadets are granted hon. commns. as Sec. Lieuts., with effect from date of their demobilisation, and one Cadet granted an hon. commn. as Sec. Lieut. with effect from date of his demobilisation.

Sec. Lieut. (Hon. Lieut.) (Actg. Capt.) C. Trenchard relinquishes his temp. R.A.F. commn.

The notification in *Gazette* of April 9 concerning Wing Comdr. L. A. Strange, D.S.C., M.C., F.D.C. is cancelled.

Oxford University and the R.A.F.

A ROYAL Air Force Reunion Dinner for members of the University was held at the Clarendon Hotel on Saturday, November 20, and much credit is due to the secretary, Capt. E. C. Haden Tebb, and all concerned in the organisation of what proved to be an entirely successful evening. Maj. H. R. Raikes, A.F.C., was in the chair, and Air-Marshal Sir Hugh Trenchard, Bart., K.C.B., D.S.O., Chief of the Air Staff, was senior guest of the evening. Other well-known figures in the aviation world who were present included Brig.-Gen. H. B. Hartley, C.B.E., M.C.; Lieut.-Col. W. O. Raikes (on behalf of Maj.-Gen. Sir Frederick Sykes, who was unavoidably prevented from attending at the last moment); Group-Capt. Blandy, D.S.O., Controller of Communications; Wing-Com. W. D. Beatty, of the Civil Air Staff; Prof. Townsend, etc.

Despite the counter-attractions of several college functions, the dinner was excellently attended, and Sir Hugh Trenchard received a most enthusiastic welcome. In replying to the toast of the "Royal Air Force," he outlined several new proposals with which he has been recently connected, and announced the sanction of a scheme whereby a number of commissions in the R.A.F. will be available for members of the Universities when they have taken their B.A. degree.

Airships on Cables

AT the last meeting of the Isle of Wight Chamber of Commerce consideration was given to a project of Mr. J. D. Roots for a service by airship between Portsmouth and Ryde. Although details are not yet available it is understood that briefly the scheme is to have a cable transmitting electricity to the airship for driving the propellers.

Air Mails to Paris and the East

THE Postmaster-General announces that from to-day, November 25, the afternoon air mail to Paris will leave Croydon Aerodrome at 12.30 p.m. instead of 1 p.m. The latest times of posting for this mail will be altered in consequence, and will be as follows:—

(*a*) Unregistered letters handed over the counter at:—West Central District office, 11.5 a.m.; General Post Office, 11 a.m.; Threadneedle-street, Lombard-street and Charing Cross branch offices and Western District office, 10.45 a.m.; South-Western District office, 10.40 a.m.; Parliament-street branch office, 10.25 a.m.; South-Eastern District office, 9 a.m. Registered letters must be handed in five minutes earlier in each case.

(*b*) Letters posted in public letter-boxes:—District offices (other than those given above), 8.30 a.m.; larger branch offices in East Central District, 9 a.m.; sub-districts, 10 p.m. to midnight.

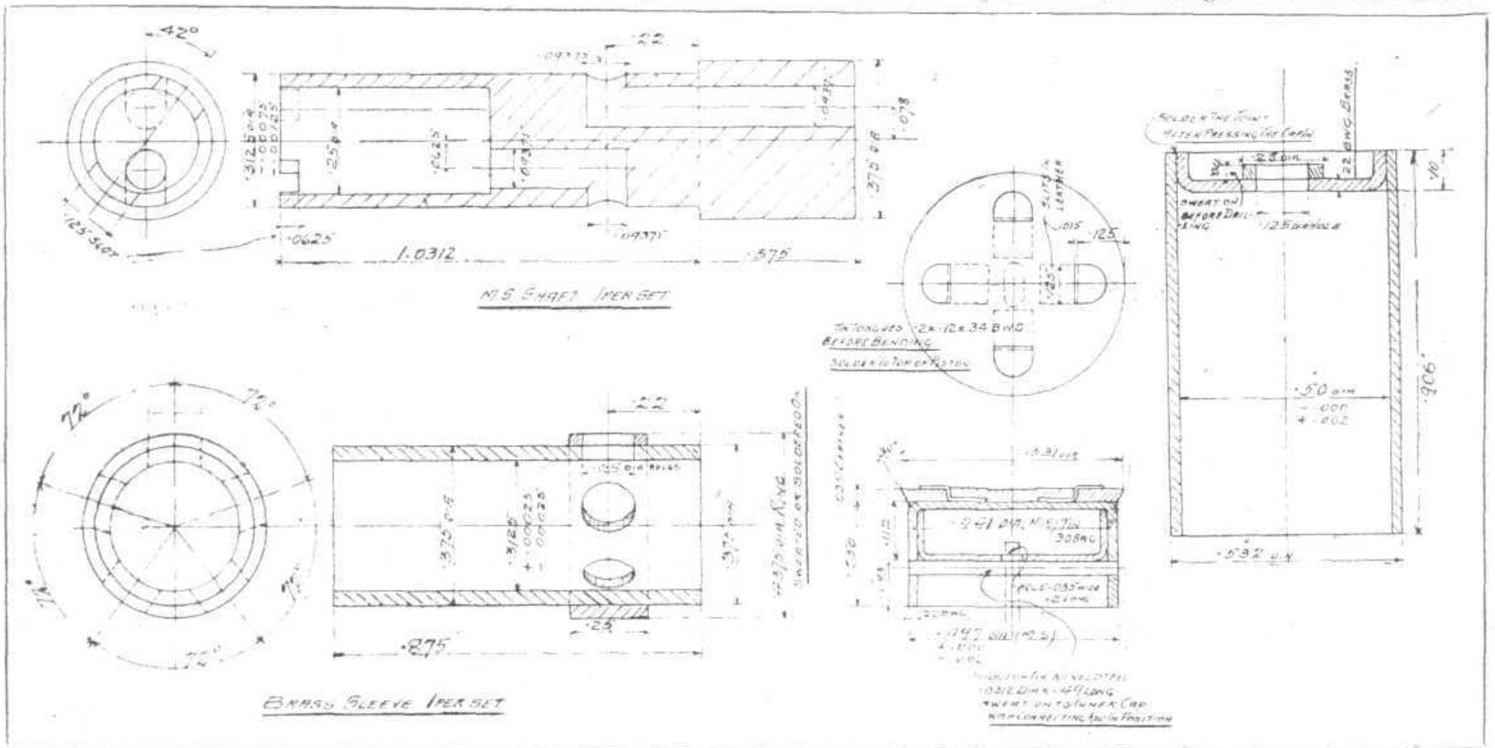
In the provinces it will be necessary to post earlier than hitherto only at some places in the south-east of England. Information should be sought from the local postmaster.

Air mail packets for Paris and Brussels and places beyond received too late for the air mail of any one day will be forwarded by the following ordinary mail when that gives a much earlier arrival than the next day's air mail, unless the packets are specially marked for the air mail of the next day.

NOTE.—*All communications should be addressed to the Model Editor. A stamp should be enclosed for a postal reply*

Compressed Air Engines

HEREWITH I show drawings of what I consider to be the best practice in making compressed air engines, so far as my experiments with rotaries are concerned. The valve I can thoroughly recommend is shown. The crankshaft, it will be seen, is made also the inlet and cut-off for the compressed air. The drawing shows a shaft suitable for a five-cylinder



rotary. Five equi-spaced holes are drilled round its encasing sleeve. In the shaft itself two diametrically opposed holes are drilled, one to form the inlet, and the other the exhaust. I have shown the limits which I consider must be worked to in order that airlocks in the shaft and leaks across the ports do not occur. The other drawings show the piston and cylinder construction, and are, I think, self-explanatory.

The Lanchester Trophy

I HEAR that the Lanchester Trophy is again to be put up for competition, and it is undecided whether to award it to the best paper on aerodynamics written by a student, or, as previously, for the best model glider. My opinion is that written papers are entirely unsatisfactory. They often do not give any indication of the knowledge of their authors. All the latter have to do is to "swot" up a given subject from existing text-books, present it in a new form, with additions or subtractions, and the paper is done. This is no mere wild statement. I write from knowledge of how it is done. It is also difficult to get the right people to judge the papers. By all means let the trophy be awarded, as previously, for the best glider, and let one of the rules be that the model must have been built by the competitor. The encouragement given to cranks by awarding trophies to papers is considerable, and people who judge such papers seldom have made good in aeronautics; neither are they designers of successful aircraft, and they often put forward projects which anybody with an elementary knowledge of aerodynamics would at once dispel as hopeless. One confesses to a fear that the awarding of such trophies is seldom a case of the best man winning.

I should also like to raise the point of manufacturers being placed in a separate class. It is unfair for the man who has only his spare time to devote to the hobby to have to compete with the skilled maker. It certainly seems to me that unless one belongs to the "vicious circle" of aeronautical nondescripts, one's work is foredoomed, its members merely "taboo" anything that does not emanate from its own little band. Books by good men are "crashed" in reviews; thoroughly "dud" ones are eulogised. It is time these things, whether relating to models or other things, stopped.

In passing, it is well to know that the present committee of the K.M.A.A. (following the practice of their predecessors in office, are having none of these things, of which more anon.

Competitions

I SUGGEST that future K.M.A.A. competitions should be run on lines similar to the following:—

(1) Judges to have had experience of actual model making and flying; this would eliminate the egregious person who is anxious to pose as an authority.

(2) Separate class for actual firms making or selling parts or complete machines; this would be of benefit to reliable firms inasmuch as the mushroom firms selling rubbish which could never fly would be squeezed out of the market. This position would be tantamount to what already obtains in other industries.

(3) Freak machines not to be encouraged, except in the junior sections. Distance and duration competitions to be for machines bearing proportions similar to those obtaining in full-size practice.

(4) Where the r.o.g. record exceeds that of the hand-launched record in the same class, the former shall be deemed to hold both records. This point created an anomalous position in previous records, where hand-launched results were considerably below the r.o.g.

(5) Local and provincial competitions to be encouraged, local official observers communicating results with the central committee as with the Farrow Shield Competition.

(6) Annual prize to be given for the best power plant (as distinct from rubber or elastic). Drawings of this to be published in the press.

(7) With "freak" machines the span to be greater than the length; rubber not to exceed one-sixth of the total weight, loading to be fixed, as well as the weight of the model. This would produce a competition where all machines would be working under the same penalty, and careful design and workmanship would thereby gain their reward.

I would also suggest that the K.M.A.A. become affiliated either to the Royal Aeronautical Society or the Royal Aero Club.

SIDEWINDS

A MONTH or two ago, H.R.H. the Duke of York very graciously accepted an aeroplane photograph of Windsor Castle, taken by Messrs. Aerofilms, Ltd., of the London Aerodrome, Hendon, N.W.9. The Queen saw and admired the photograph in the Duke's residence, and asked if a copy could be secured for herself to hang in the library at Windsor Castle, and Messrs. Aerofilms were honoured with a request to supply same, together with an additional copy illustrating a further position of Windsor Castle, to make a pair of pictures for the library.

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MESSRS. AEROFILMS, LTD., pioneers of aerial photography on a commercial basis in the United Kingdom, have since the War been extremely active in securing fine pictorial results all over England. At the present moment aerial photographic survey is being used extensively by enterprising town councils and estate agents for assisting in the developing of town planning and housing schemes. Also aerial survey parties are being arranged for work abroad, on plantations and undeveloped land where no ground survey has yet been made. It is found that by surveying large areas from the air, only taking a month or two to complete, makes a saving of some thousands of pounds over the cost of ground surveying, which takes years to complete, according to the area to be covered.

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ONE of the most interesting publications on carburation is the latest booklet, dealing with Claudel-Hobson carburettors, issued by Messrs. H. M. Hobson, Ltd. It explains most clearly the working of the various models of this particular make of carburettor, and the description of what happens to petrol and air, written in lucid and clear phraseology, becomes simplicity itself with the aid of the clever, coloured, sectional diagrams. Both the "A," or the air injector type of jet, and the "Z," or diffuser type, are treated fully, their working principles and the reasons which have led to the adoption of these principles being explained at some length. The different models are then briefly described, their characteristics being detailed, while the purpose for which they are most suitable also comes in for attention. For the practical man, the most interesting chapters in the book will doubtless be those devoted to "Fitting Instructions" and "Notes on Adjustment." Another useful feature is the "Table of Faults," which, after giving the "symptoms" of the faulty running of an engine, goes on to indicate what to look for in the engine and in the carburettor, then proceeds to outline the "cure."

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THE other features of the book are a series of illustrations giving the names of the various parts of the carburettor, a table of prices and dimensions, a price list of spare parts and a list of fitting accessories. The book is one which should be obtained by everyone having to do with the care and maintenance of aircraft engines, and a line to Messrs. H. M. Hobson, Ltd., 29, Vauxhall Bridge Road, S.W.1, will bring a copy by return.

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AN analysis of the cars exhibited at the recent Motor Show, Olympia and White City, brings out the interesting fact that Lodge Plugs were fitted to no less than 52 per cent. of the British cars on view. As Lodge plugs are not the cheapest plugs to buy, this is confirmation that the best British car makers set quality and efficiency before mere cheapness.

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ALTHOUGH issued free, with the compliments of Messrs. C. C. Wakefield and Co., Ltd., a twenty-four page booklet dealing with "Efficiency in Lubrication" deserves careful study, for apart from "Castrol," naturally a leading theme, it contains interesting facts about viscosity, specific gravity, flash point, emulsification and other matters, passing onward to power-house problems, estimating the power of steam or gas engines, and the initial combustion pressure of gas engines—each division being treated with technical precision, supported by illustrative formulæ. Insisting on the study of lubrication problems from the chemical aspect, it is stated: "Factors such as deposits caused by superheated steam, deposits in turbines, sludge deposits in electric transformers, difficulties in the lubrication of Diesel engines and air compressors, etc., are subjects on which considerable work has been carried on here and suitable oils evolved to meet the conditions." Supplementing this, we have the assurance that the Wakefield Research Department is at the service of interested parties. A copy of the brochure, which is well printed on fine paper, may be obtained from Wakefield House, Cheapside, E.C.2.

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THERE were approximately 340 motor-cars on exhibition at Olympia and the White City that were fitted with British lighting and starting sets. Of this total, Messrs. C. A. Vandervell and Co. of Acton claim no less a percentage than 40 per cent., and 45 per cent. more than the nearest British competitor.

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A GOOD thing cannot happen too soon or too often, and Burberrys' action in anticipating their annual sale and beginning it on December 1 next, instead of in the New Year, will be welcomed by the many people who are anxiously awaiting an opportunity to replenish their wardrobes at about half the usual prices. The reason for this change of date is one of annual accounting, which makes it more convenient for the firm to close its books a month earlier than hitherto. Large stocks of models have accumulated during the year, and a great many weatherproof topcoats, suits and gowns of superb quality and distinction, specially designed for sport, recreation or business, have been made up from short lengths and surplus materials.

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ANOTHER attractive innovation of the sale is that a quantity of fine suit, gown and overcoat cloths will be made up *to order* at special prices. Patterns of these materials may be inspected at Haymarket. An illustrated catalogue of the sale both for the men's and women's departments is published, with measure forms and particulars as to conditions and prices, which will be sent post free on application by postcard to Burberrys, Ltd., Haymarket, S.W.1.

AERONAUTICAL PATENT SPECIFICATIONS

Abbreviations:—cyl. = cylinder; I.C. = internal combustion; m. = motors

The numbers in brackets are those under which the Specifications will be printed and abridged, etc.

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